4.0 REAL-TIME DATA SYSTEMS FOR LOCAL USERS

This section describes the real-time systems which are available for NOAA KLM direct readout users. These systems include the High Resolution Picture Transmission (HRPT), the Automatic Picture Transmission (APT), Direct Sounder Broadcast (DSB) and the Data Collection System (DCS). Transmission characteristics, data frame formats and synchronization details are given for each of the above mentioned systems.

4.1 HRPT SYSTEM

4.1.1 GENERAL

The High Resolution Picture Transmission (HRPT) system provides data from all spacecraft instruments at a rate of 665,400 bps. The S-band realtime transmission consists of the digitized unprocessed output of five AVHRR/3 channels, plus the TIP (HIRS/3, SBUV/2, SEM, DCS/2) data and AMSU data. All information necessary to calibrate the instrument outputs is included in the data stream.

During NOAA-K activation and evaluation, it was determined that AMSU-A channels 7 and 15 were switched. This switch should be transparent to Level 1b users as the channels were corrected (switched back) by the ingest software, however, direct readout users should be aware of this problem. Only the radiometric data was affected, the housekeeping temperatures of channels 15 and 7 oscillators are correct as they are now. The antenna patterns, beam efficiency and beam widths are correct as they were not affected by the switch. Band pass for channels 7 and 15 was not affected due to extremely broad rf-detectors.

4.1.2 TRANSMISSION CHARACTERISTICS

The S-band transmission of time multiplexed, digital data is in a split phase format. Split phase data "0" is defined as being +68 degrees phase during the first half of the bit period and -68 degrees during the second half of the bit period. The split phase data "1" is defined as being -68 degrees phase during the first half of the bit period and +68 degrees phase during the second half of the bit period. Table 4.1.2-1 shows the general characteristics of the HRPT transmission system, while the general HRPT parameters are shown in Table 4.1.2-2.

4.1.3 HRPT MINOR FRAME FORMAT

The MIRP outputs the HRPT format simultaneously with the Automatic Picture Transmission (APT), Global Area Coverage (GAC) and Local Area Coverage (LAC) formats. GAC and LAC data are not considered real time, as these data are stored on the spacecraft digital recorders for readout by the CDA stations. The HRPT data format consists of a major frame which is subdivided into three minor frames. On NOAA KLM, TIP and AMSU data are updated at the major frame rate. That is, the three minor frames which make up the major frame will contain TIP

data in the first minor frame, backfill in the second minor frame, and AMSU data from the AIP, in the third minor frame. In the previous series of satellites (NOAA E-J), the major frame consisted of three minor frames of only the TIP data. The details of the minor frame formats are shown in Tables 4.1.3-1, 4.1.3-2 and Figure 4.1.3-1.

Of special note here is the flag in the telemetry (Word 7, Bit 10) which will indicate which of AVHRR/3 channel 3 sensors (3A or 3B) is operating. When channel 3B is selected, the patch temperature data is output every scan line (during the backscan), and every other scan line when channel 3A is selected. The data output will switch instantaneously between 3A or 3B upon command, even if the scan is in the middle of a line. However, the way the flag operates there is one scan line of uncertainty when switching from 3B to 3A, and two lines of uncertainty when switching from 3A to 3B.

Table 4.1.2-1. HRPT Transmission Characteristics.	
Line Rate	360 lines/minute
Data Channels	5 transmitted, 6 available
Data Resolution	1.1 km
Carrier Modulation	Digital split phase, phase modulated
Transmitter Frequency (MHz)	1698.0 or 1707.0 MHz primary, 1702.5 MHz secondary
Transmitter Power (EOL)	6.35 W (38.03 dBm)
Radiated Power (dBm, @ 63 degrees)	40.13
Polarization	RCP

Table 4.1.2-2. HRPT Parameters.	
Major Frame	
Rate	2 major frames/sec
Minor Frames/Major Frame	3
Minor Frame	
Rate	6 minor frames/sec
Number of words	11090
Format	See Table 4.1.3-1

Word Parameters	
Rate	66,540 words/sec
Number of bits/word	10
Order	Bit 1=MSB, Bit 10=LSB
Bit Parameters	
Rate	665,400 bits/sec
Format	Split phase
Data "0"	+68/-68 degrees
Data "1"	-68/+68 degrees

Table 4.1.3-1. HRPT Minor Frame Format.

Function	No. of Words	Word Position	Bit No. 1 2 3 4 5 6 7 8 9 10 Plus Word Code & Meaning
Frame Sync	6	1	1 0 1 0 0 0 0 1 0 0
		2	0 1 0 1 1 0 1 1 1 1
		3	1 1 0 1 0 1 1 1 0 0 See Note 1
		4	0 1 1 0 0 1 1 1 0 1
		5	1 0 0 0 0 0 1 1 1 1
		6	0 0 1 0 0 1 0 1 0 1
ID	2	7	Bit 1; 0=Internal Sync; 1=AVHRR Sync Bits 2 & 3; 00=Not an HRPT frame but a GAC frame; 01=Minor Frame #1; 10=Minor Frame #2; 11=Minor Frame #3 Bits 4-7; Spacecraft Addresses; Bit 4=MSB, BIT 7=LSB Bit 8; 0=Frame Stable; 1=Frame Resync Occurred Bit 9; 1=Normal AVHRR input, 0=PN AVHRR Input Bit 10; 0=AVHRR Ch3B, 1=AVHRR Ch3A
		8	Bits 1-10; undefined Spare
Time Code	4	9	Bits 1-9; Binary day count; Bit 1 = MSB; Bit 9 = LSB Bit 10; 0; spare
		10	Bit 1-3; 101, spare Bits 4-10; Part of Binary msec of day count; Bit 4=MSB
		11	Bit 1-10; Part of Binary msec of day count;

		12	Bit 1-10; Remainder of Binary msec of day count; Bit 10=LSB
Telemetry	10	13	Ramp Calibration AVHRR Channel #1
		14	Ramp Calibration AVHRR Channel #2
		15	Ramp Calibration AVHRR Channel #3
		16	Ramp Calibration AVHRR Channel #4
		17	Ramp Calibration AVHRR Channel #5
		18	PRT Reading 1
		19	PRT Reading 2
		20	PRT Reading 3 See Note 2
		21	Channel 3 patch Temp.
		22	Spare - Undefined
Calibration Target View	30	23 thru 52	10 words of calibration target view data from each AVHRR channel 3, 4, and 5. These data are time multiplexed as chan 3 (word 1), chan 4 (word 1), chan 5 (word 1), chan 3 (word 2), chan 4 (word 2), chan 5 (word 2), etc.
Space Data	50	53 thru 102	10 words of space scan data from each AVHRR channel 1, 2, 3, 4, and 5. These data are time multiplexed as chan 1 (word 1), chan 2 (word 1), chan 3 (word 1), chan 4 (word 1) chan 5 (word 1), chan 1 (word 2), chan 2 (word 2), chan 3 (word 2), chan 4 (word 2), chan 5 (word 2), etc.
Sync Data	1	103	Bit 1; 0 = AVHRR sync early; 1 = AVHRR sync late, Bits 2-10; 9 bit binary count of 0.9984 MHz periods; Bit 2 = MSB, Bit 10=LSB
Data Words	520	104 thru 623	3 sets of data corresponding to three HRPT minor frames per HRPT major frame. First HRPT minor frame: The 520 words contain 5 TIP minor frames of TIP data (104 TIP data words per TIP minor frame) Bits 1-8: Exact format as generated by TIP. Bit 9: Even parity check over Bits 1-8. Bit 10: Inverted Bit 1. Second HRPT minor frame: The 520 words shall consist of five frames (104 words per frame) of spare data in the same form as spare words 624-750. Third HRPT minor frame: The 520 words shall consist of five frames (104 words per frame-see Note 3)of AMSU data from the AIP. Bits 1-8: Exact format as generated by AIP. Bit 9: Even parity check over Bits 1-8. Bit 10: Inverted Bit 1. (See Note 3.)

Spare Words	127	624	1 0 1 0 0 0 1 1 1 0
		625	1 1 1 0 0 0 1 0 1 1
		626	0 0 0 0 1 0 1 1 1 1
		627	1 0 1 1 0 0 0 1 1 1
		628	1 1 0 1 0 1 0 0 1 0
		...	... See Note 4
		748	1 0 0 1 0 1 1 0 1 0
		749	1 1 0 0 1 0 0 0 1 0
		750	1 0 0 0 0 0 0 0 0 0
Earth Data	10,240	751	Chan 1 - Sample 1
		752	Chan 2 - Sample 1
		753	Chan 3 - Sample 1
		754	Chan 4 - Sample 1
		755	Chan 5 - Sample 1
		756	Chan 1 - Sample 2
		...	... See Note 5
		10,985	Chan 5 - Sample 2047
		10,986	Chan 1 - Sample 2048
		10,987	Chan 2 - Sample 2048
		10,988	Chan 3 - Sample 2048
		10,989	Chan 4 - Sample 2048
		10,990	Chan 5 - Sample 2048
Auxiliary Sync	100	10,991	1 1 1 1 1 0 0 0 1 0
		10,992	1 1 1 1 1 1 0 0 1 1
		10,993	0 1 1 0 1 1 0 1 0 1
		10,994	1 0 1 0 1 1 1 1 0 1
		...	... See Note 6
		11,089	0 1 1 1 1 1 0 0 0 0
		11,090	1 1 1 1 0 0 1 1 0 0

Notes:
1) First 60 bits from 63 bit PN generator started in the all 1's state. The generator polynomial is $X^6+X^5+X^2+X+1$
2) AVHRR Internal Target Temperature Data. Three readings from one of the four platinum resistance thermometers (PRT). A different PRT is sampled for each scan; every fifth scan will contain a reference value of 0 in place of each reading.
3) The 104th word of each AMSU data frame of the MIRP contains 1110110100.
4) Derived by inverting the output of a 1023 bit PN sequence provided by a feedback shift register generating the polynomial: $X^{10}+X^5+X^2+X+1$. The generator is started in all 1's state at the beginning of word 7 of each minor frame.
5) Each minor frame contains the data obtained during one Earth scan of the AVHRR sensor. The data from the five sensor channels of the AVHRR are time multiplexed as indicated.
6) Derived from the non-inverted output of a 1023 bit PN sequence provided by a feedback shift register generating the polynomial: $X^{10}+X^5+X^2+X+1$. The generator is started in the all 1's state at the beginning of word 10,991.

Figure 4.1.3-1. AIP Output Format.

0 1 2 22-bit sync		3 ///	4 MFC	5 1)	6 7 ///	8 ----------AMSU-A1 (Words 8 through 33)----------													20
21 ----------AMSU-A1----------															33	34 ----------AMSU-A2 (Words 34			40
41 through 47)----------															47	48 --------AMSU-B (Words 48 through 97)----------			60
61 ----------AMSU-B----------																			80
81 ----------AMSU-B----------															97	98 ///			100
101 ///	102 2)	103 105 20-bit sync SC ID		106 1), 3)	107 3), 4)	108 4)	109 110 CMMD VER	111 5)	112 114 Analog subcom 32/16/1 seconds		115 5)	116 6)	117 DAU 1	118 DAU2	119 HIRS/3	120 HIRS/3			
121 122 DCS-2		123 124 SEM		125 126 HIRS/3		127 128 DCS-2		129 130 HIRS/3		131 132 DCS-2		133 134 HIRS/3		135 136 DCS-2		137 138 HIRS/3		139 140 SBUV/2	
141 142 HIRS/3		143 144 DCS-2		145 146 HIRS/3		147 148 DCS-2		149 ----------CPU Telemetry----------						154 155 156 DCS-2		157 158 HIRS/3		159 160 DCS-2	
161 162 HIRS/3/		163 164 DCS-2		165 166 HIRS/3		167 168 HIRS/3		169 170 HIRS/3		171 172 DCS-2		173 174 HIRS/3		175 176 DCS-2		177 178 HIRS/3		179 180 DCS-2	
181 182 HIRS/3		183 184 SBUV/2		185 186 HIRS/3		187 188 HIRS/3		189 190 DCS-2		191 192 HIRS/3		193 194 DCS-2		195 196 HIRS/2		197 198 DCS-2		199 200 ----CPU	
201 204 Telemetry----------				205 ///		206 207 7)													

NOTES: /// indicates spare bits and reads 010101, etc.
1) Words 5 and 106: Bit 1-Command Verification Status, Bits 2 & 3- TIP status, Bits 4, 5 & 6- Major Frame Counter
2) Word 102: Bits 1 & 2 spare, followed by 6 bits AMSU parity
3) Words 106 and 107: 9 Bit Dwell address
4) Words 107 and 108: 9 Bit Subcommutation counter
5) Digital-B Subcommutation (32 second)
6) Analog Subcommutation
7) Word 206: 2 bits CPU data status followed by 6 bits TIP parity; word 207: 2 bits spare followed by 6 bits TIP parity calculated by AIP

4.1.4 DIGITAL "A" TELEMETRY

4.1.4.1 AMSU-A1

The AMSU-A1 Digital "A" telemetry incorporates all of the radiometric data taken during one scan. It also includes the data from the on-orbit calibrations. In the Full Scan Mode, the AMSU-A1 has 1,244 Digital "A" telemetry points, as identified in Table 4.1.4.1-1.

Table 4.1.4.1-1. AMSU-A1 Digital "A" Data Format - Full Scan Mode.

A1 Frame Byte Number	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector 1, Position 1, MSP, First reading
10	Reflector 1, Position 1, LSP, First reading
11	Reflector 2, Position 1, MSP, First reading
12	Reflector 2, Position 1, LSP, First reading
13	Reflector 1, Position 1, MSP, Second reading
14	Reflector 1, Position 1, LSP, Second reading
15	Reflector 2, Position 1, MSP, Second reading
16	Reflector 2, Position 1, LSP, Second reading
17	Scene Position 1, Channel 3, MSP
18	Scene Position 1, Channel 3, LSP
19	Scene Position 1, Channel 4, MSP
20	Scene Position 1, Channel 4, LSP
...	...
41	Scene Position 1, Channel 15, MSP

42	Scene Position 1, Channel 15, LSP
43	Reflector 1, Position 2, MSP, First reading
44	Reflector 1, Position 2, LSP, First reading
45	Reflector 2, Position 2, MSP, First reading
46	Reflector 2, Position 2, LSP, First reading
47	Reflector 1, Position 2, MSP, Second reading
48	Reflector 1, Position 2, LSP, Second reading
49	Reflector 2, Position 2, MSP, Second reading
50	Reflector 2, Position 2, LSP, Second reading
51	Scene Position 2, Channel 3, MSP
52	Scene Position 2, Channel 3, LSP
...	...
75	Scene Position 2, Channel 15, MSP
76	Scene Position 2, Channel 15, LSP
77	Reflector 1, Position 3, MSP, First reading
78	Reflector 1, Position 3, LSP, First reading
79	Reflector 2, Position 3, MSP, First reading
80	Reflector 2, Position 3, LSP, First reading
81	Reflector 1, Position 3, MSP, Second reading
82	Reflector 1, Position 3, LSP, Second reading
83	Reflector 2, Position 3, MSP, Second reading
84	Reflector 2, Position 3, LSP, Second reading
85	Scene Position 3, Channel 3, MSP
86	Scene Position 3, Channel 3, LSP
...	...
1027	Scene Position 30, Channel 15, MSP
1028	Scene Position 30, Channel 15, LSP

1029	Reflector 1, Cold Cal. Position, MSP, First reading
1030	Reflector 1, Cold Cal. Position, LSP, First reading
1031	Reflector 2, Cold Cal. Position, MSP, First reading
1032	Reflector 2, Cold Cal. Position, LSP, First reading
1033	Reflector 1, Cold Cal. Position, MSP, Second reading
1034	Reflector 1, Cold Cal. Position, LSP, Second reading
1035	Reflector 2, Cold Cal. Position, MSP, Second reading
1036	Reflector 2, Cold Cal. Position, LSP, Second reading
1037	Cold Calibration 1, Channel 3, MSP
1038	Cold Calibration 1, Channel 3, LSP
1039	Cold Calibration 1, Channel 4, MSP
1040	Cold Calibration 1, Channel 4, LSP
...	...
1061	Cold Calibration 1, Channel 15, MSP
1062	Cold Calibration 1, Channel 15, LSP
1063	Cold Calibration 2, Channel 3, MSP
1064	Cold Calibration 2, Channel 3, LSP
1065	Cold Calibration 2, Channel 4, MSP
1066	Cold Calibration 2, Channel 4, LSP
...	...
1087	Cold Calibration 2, Channel 15, MSP
1088	Cold Calibration 2, Channel 15, LSP
1089	Temp Sensor 1, MSP
1090	Temp Sensor 1, LSP
1091	Temp Sensor 2, MSP
1092	Temp Sensor 2, LSP
...	...

1177	Temp Sensor 45, MSP
1178	Temp Sensor 45, LSP
1179	Temp Sensor Reference Voltage, MSP
1180	Temp Sensor Reference Voltage, LSP
1181	Reflector 1 Warm Cal. Position, MSP, First reading
1182	Reflector 1 Warm Cal. Position, LSP, First reading
1183	Reflector 2 Warm Cal. Position, MSP, First reading
1184	Reflector 2 Warm Cal. Position, LSP, First reading
1185	Reflector 1 Warm Cal. Position, MSP, Second reading
1186	Reflector 1 Warm Cal. Position, LSP, Second reading
1187	Reflector 2 Warm Cal. Position, MSP, Second reading
1188	Reflector 2 Warm Cal. Position, LSP, Second reading
1189	Warm Calibration 1, Channel 3, MSP
1190	Warm Calibration 1, Channel 3, LSP
...	...
1213	Warm Calibration 1, Channel 15, MSP
1214	Warm Calibration 1, Channel 15, LSP
1215	Warm Calibration 2, Channel 3, MSP
1216	Warm Calibration 2, Channel 3, LSP
...	...
1239	Warm Calibration 2, Channel 15, MSP
1240	Warm Calibration 2, Channel 15, LSP
...	...
1241-1243	Sync. Sequence (FF Hex)
1244	Unit Identification and Serial Number
Notes: 1) The MSP is the most significant portion of a particular measurement; the LSP is the least significant portion of the particular measurement.	

2) The first set of readings for a particular reflector position are made prior to the integration interval; the second set of readings are made approximately ½ way through the integration period.
3) Digital "A" data as read by the spacecraft shall contain an undetermined number of "fill words". These fill words shall be 0001H and will be intermingled with valid data. The Digital "A" data as sent by the instrument shall be such that no valid data of 0001H shall be included.
4) Format of Position data is: DDDDDDDDDDDDDE0, where:
D = Data
E = Error bit: 0=not in spec, 1=spec.
0 = Zero
5) Format of Radiometer data is: DDDDDDDDDDDDDD0, where:
D = Data
0 = Zero
6) Temperature Sensor Reference Voltage utilized for temperature sensors 36-45 only.

4.1.4.2 AMSU-A2

The AMSU-A2 Digital "A" telemetry incorporates all of the radiometric data taken during one scan. It also includes the data from the on-orbit calibrations. The AMSU-A2 has 316 Digital "A" telemetry points, as described in Table 4.1.4.2-1, in the Full Scan Mode.

Table 4.1.4.2-1. AMSU-A2 Digital "A" Format - Full Scan Mode.

A2 Frame Byte Number	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector, Position 1, MSP, First reading
10	Reflector, Position 1, LSP, First reading
11	Reflector, Position 1, MSP, Second reading
12	Reflector, Position 1, LSP, Second reading

13	Scene Position 1, Channel 1, MSP
14	Scene Position 1, Channel 1, LSP
15	Scene Position 1, Channel 2, MSP
16	Scene Position 1, Channel 2, LSP
17	Reflector, Position 2, MSP, First reading
18	Reflector, Position 2, LSP, First reading
19	Reflector, Position 2, MSP, Second reading
20	Reflector, Position 2, LSP, Second reading
21	Scene Position 2, Channel 1, MSP
22	Scene Position 2, Channel 1, LSP
23	Scene Position 2, Channel 2, MSP
24	Scene Position 2, Channel 2, LSP
25	Reflector, Position 3, MSP, First reading
26	Reflector, Position 3, LSP, First reading
27	Reflector, Position 3, MSP, Second reading
28	Reflector, Position 3, LSP, Second reading
29	Scene Position 3, Channel 1, MSP
30	Scene Position 3, Channel 1, LSP
...	...
247	Scene Position 30, Channel 2, MSP
248	Scene Position 30, Channel 2, LSP
249	Reflector, Cold Calibration Position, MSP, First reading
250	Reflector, Cold Calibration Position, LSP, First reading
251	Reflector, Cold Calibration Position, MSP, Second reading
252	Reflector, Cold Calibration Position, LSP, Second reading
253	Cold Calibration 1, Channel 1, MSP
254	Cold Calibration 1, Channel 1, LSP

255	Cold Calibration 1, Channel 2, MSP
256	Cold Calibration 1, Channel 2, LSP
257	Cold Calibration 2, Channel 1, MSP
258	Cold Calibration 2, Channel 1, LSP
259	Cold Calibration 2, Channel 2, MSP
260	Cold Calibration 2, Channel 2, LSP
261	Temperature Sensor 1, MSP
262	Temperature Sensor 1, LSP
263	Temperature Sensor 2, MSP
264	Temperature Sensor 2, LSP
...	...
297	Temperature Sensor 19, MSP
298	Temperature Sensor 19, LSP
299	Temperature Sensor Reference Voltage, MSP
300	Temperature Sensor Reference Voltage, LSP
301	Reflector Warm Calibration Position, MSP, First reading
302	Reflector Warm Calibration Position, LSP, First reading
303	Reflector Warm Calibration Position, MSP, Second reading
304	Reflector Warm Calibration Position, LSP, Second reading
305	Warm Calibration 1, Channel 1, MSP
306	Warm Calibration 1, Channel 1, LSP
307	Warm Calibration 1, Channel 2, MSP
308	Warm Calibration 1, Channel 2, LSP
309	Warm Calibration 2, Channel 1, MSP
310	Warm Calibration 2, Channel 1, LSP
311	Warm Calibration 2, Channel 2, MSP
312	Warm Calibration 2, Channel 2, LSP

313-315	Synchronization Sequence (FF Hex)
316	Unit Identification and Serial Number

Notes:
1) MSP is the most significant portion of a particular measurement while the LSP is the least significant portion of the particular measurement.
2) The first set of readings for a particular reflector position are made prior to the integration interval; the second set of readings are made approximately half way through the integration period.
3) Digital "A" data as read by the spacecraft shall contain an undetermined number of "fill words". These fill words shall be 0001H and will be intermingled with valid data. The Digital "A" data as sent by the instrument shall be such that no valid data of 0001H shall be included.
4) Format of Position data is DDDDDDDDDDDDDE0, where:
D=Data
E=Error bit: 0=not in spec, 1=spec.
0=Zero
5) Format of Radiometer data is DDDDDDDDDDDDDD0, where:
D=Data
0=Zero
6) Temperature sensor reference voltage is utilized for temperature sensors 13 through 19 only.

4.1.4.3 AMSU-B

Digital "A" Data is clocked into the spacecraft AIP at a 16.64 kbps rate by the shift pulse whenever the Data Enable Pulse is presented to the instrument. The AMSU-B data is in the AIP minor frame words 48 through 97. The AIP reads the digital data output from the AMSU-B in 16 bit words.

The AMSU-B telemetry format consists of 78 minor frames of data. Minor frames 1 and 80 in each 8 second cycle are blank: i.e. no data is available in the PEU digital data FIFO during the first and last minor frames of each 8 second format. The 78 minor frames are organized as three blocks of 650 words as follows (representing one scan of the instrument):

36 spare words

540 words of Earth view pixel data
(90 x (5 channels + shaft position at mid-pixel))

26 words of housekeeping data

48 words of space view and target view data
(2 x 4 x (5 channels + shaft position))

This structure is maintained for all modes. In static modes, all pixel data locations contain the pixel data for the current antenna position.

The AMSU-B digital format is synchronized to the 8 second synchronization pulse. During each minor frame, 25 words of data are available in the PEU O/P FIFO within 16.7 ms of the start of the minor frame (except in frames 1 and 80). Figure 4.1.4.3-1 shows the AMSU-B digital A data format.

Word Length: 16 bits

Serial Output: 25 - 16 bit words per 100 sec (MSB first)

Table 4.1.4.3-1. AMSU-B Data Format.										
Word Number	**Minor Frame**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
01	Blank	SP1	SP26	17/03	18/07	19/11	20/15	P/20	16/24	17/28
02		SP2	SP27	18/03	19/07	20/11	P/16	16/20	17/24	18/28
03		SP3	SP28	19/03	20/07	P/12	16/16	17/20	18/24	19/28
04		SP4	SP29	20/03	P/08	16/12	17/16	18/20	19/24	20/28
05		SP5	SP30	P/04	16/08	17/12	18/16	19/20	20/24	P/29
06		SP6	SP31	16/04	17/08	18/12	19/16	20/20	P/25	16/29
07		SP7	SP32	17/04	18/08	19/12	20/16	P/21	16/25	17/29
08		SP8	SP33	18/04	19/08	20/12	P/17	16/21	17/25	18/29
09		SP9	SP34	19/04	20/08	P/13	16/17	17/21	18/25	19/29
10		SP10	SP35	20/04	P/09	16/13	17/17	18/21	19/25	20/29
11		SP11	SP36	P/05	16/09	17/13	18/17	19/21	20/25	P/30
12		SP12	P/01	16/05	17/09	18/13	19/17	20/21	P/26	16/30
13		SP13	16/01	17/05	18/09	19/13	20/17	P/22	16/26	17/30
14		SP14	17/01	18/05	19/09	20/13	P/18	16/22	17/26	18/30
15		SP15	18/01	19/05	20/09	P/14	16/18	17/22	18/26	19/30
16		SP16	19/01	20/05	P/10	16/14	17/18	18/22	19/26	20/30
17		SP17	20/01	P/06	16/10	17/14	18/18	19/22	20/26	P/31
18		SP18	P/02	16/06	17/10	18/14	19/18	20/22	P/27	16/31
19		SP19	16/02	17/06	18/10	19/14	20/18	P/23	16/27	17/31
20		SP20	17/02	18/06	19/10	20/14	P/19	16/23	17/27	18/31
21		SP21	18/02	19/06	20/10	P/15	16/19	17/23	18/27	19/31
22		SP22	19/02	20/06	P/11	16/15	17/19	18/23	19/27	20/31
23		SP23	20/02	P/07	16/11	17/15	18/19	19/23	20/27	P/32

24		SP24	P/03	16/07	17/11	18/15	19/19	20/23	P/28	16/32
25		SP25	16/03	17/07	18/11	19/15	20/19	P/24	16/28	17/32
Word Number	**Minor Frame**									
	11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
01	18/32	19/36	20/40	P/45	16/49	17/53	18/57	19/61	20/65	P/70
02	19/32	20/36	P/41	16/45	17/49	18/53	19/57	20/61	P/66	16/70
03	20/32	P/37	16/41	17/45	18/49	19/53	20/57	P/62	16/66	17/70
04	P/33	16/37	17/41	18/45	19/49	20/53	P/58	16/62	17/66	18/70
05	16/33	17/37	18/41	19/45	20/49	P/54	16/58	17/62	18/66	19/70
06	17/33	18/37	19/41	20/45	P/50	16/54	17/58	18/62	19/66	20/70
07	18/33	19/37	20/41	P/46	16/50	17/54	18/58	19/62	20/66	P/71
08	19/33	20/37	P/42	16/46	17/50	18/54	19/58	20/62	P/67	16/71
09	20/33	P/38	16/42	17/46	18/50	19/54	20/58	P/63	16/67	17/71
10	P/34	16/38	17/42	18/46	19/50	20/54	P/59	16/63	17/67	18/71
11	16/34	17/38	18/42	19/46	20/50	P/55	16/59	17/63	18/67	19/71
12	17/34	18/38	19/42	20/46	P/51	16/55	17/59	18/63	19/67	20/71
13	18/34	19/38	20/42	P/47	16/51	17/55	18/59	19/63	20/67	P/72
14	19/34	20/38	P/43	16/47	17/51	18/55	19/59	20/63	P/68	16/72
15	20/34	P/39	16/43	17/47	18/51	19/55	20/59	P/64	16/68	17/72
16	P/35	16/39	17/43	18/47	19/51	20/55	P/60	16/64	17/68	18/72
17	16/35	17/39	18/43	19/47	20/51	P/56	16/60	17/64	18/68	19/72
18	17/35	18/39	19/43	20/47	P/52	16/56	17/60	18/64	19/68	20/72
19	18/35	19/39	20/43	P/48	16/52	17/56	18/60	19/64	20/68	P/73
20	19/35	20/39	P/44	16/48	17/52	18/56	19/60	20/64	P/69	16/73
21	20/35	P/40	16/44	17/48	18/52	19/56	20/60	P/65	16/69	17/73
22	P/36	16/40	17/44	18/48	19/52	20/56	P/61	16/65	17/69	18/73

23	16/36	17/40	18/44	19/48	20/52	P/57	16/61	17/65	18/69	19/73
24	17/36	18/40	19/44	20/48	P/53	16/57	17/61	18/65	19/69	20/73
25	18/36	19/40	20/44	P/49	16/53	17/57	18/61	19/65	20/69	P/74
Word Number	**Minor Frame**									
	21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
01	16/74	17/78	18/82	19/86	20/90	A25	20/S4	SP1	TST09	17/03
02	17/74	18/78	19/82	20/86	A01	A26	P/T1	SP2	TST10	18/03
03	18/74	19/78	20/82	P/87	A02	P/S1	16/T1	SP3	TST11	19/03
04	19/74	20/78	P/83	16/87	A03	16/S1	17/T1	SP4	TST12	20/03
05	20/74	P/79	16/83	17/87	A04	17/S1	18/T1	SP5	TST13	P/04
06	P/75	16/79	17/83	18/87	A05	18/S1	19/T1	SP6	TST14	16/04
07	16/75	17/79	18/83	19/87	A06	19/S1	20/T1	SP7	TST15	17/04
08	17/75	18/79	19/83	20/87	A07	20/S1	P/T2	SP8	TST16	18/04
09	18/75	19/79	20/83	P/88	A08	P/S2	16/T2	SP9	TST17	19/04
10	19/75	20/79	P/84	16/88	A09	16/S2	17/T2	SP10	TST18	20/04
11	20/75	P/80	16/84	17/88	A10	17/S2	18/T2	SP11	TST19	P/05
12	P/76	16/80	17/84	18/88	A11	18/S2	19/T2	SP12	P/01	16/05
13	16/76	17/80	18/84	19/88	A12	19/S2	20/T2	SP13	16/01	17/05
14	17/76	18/80	19/84	20/88	A13	20/S2	P/T3	SP14	17/01	18/05
15	18/76	19/80	20/84	P/89	A14	P/S3	16/T3	SP15	18/01	19/05
16	19/76	20/80	P/85	16/89	A15	16/S3	17/T3	SP16	19/01	20/05
17	20/76	P/81	16/85	17/89	A16	17/S3	18/T3	SP17	20/01	P/06
18	P/77	16/81	17/85	18/89	A17	18/S3	19/T3	TST01	P/02	16/06
19	16/77	17/81	18/85	19/89	A18	19/S3	20/T3	TST02	16/02	17/06
20	17/77	18/81	19/85	20/89	A19	20/S3	P/T4	TST03	17/02	18/06
21	18/77	19/81	20/85	P/90	A20	P/S4	16/T4	TST04	18/02	19/06

22	19/77	20/81	P/86	16/90	A21	16/S4	17/T4	TST05	19/02	20/06
23	20/77	P/82	16/86	17/90	A22	17/S4	18/T4	TST06	20/02	P/07
24	P/78	16/82	17/86	18/90	A23	18/S4	19/T4	TST07	P/03	16/07
25	16/78	17/82	18/86	19/90	A24	19/S4	20/T4	TST08	16/03	17/07
Word Number	**Minor Frame**									
	31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
01	18/07	19/11	20/15	P/20	16/24	17/28	18/32	19/36	20/40	P/45
02	19/07	20/11	P/16	16/20	17/24	18/28	19/32	20/36	P/41	16/45
03	20/07	P/12	16/16	17/20	18/24	19/28	20/32	P/37	16/41	17/45
04	P/08	16/12	17/16	18/20	19/24	20/28	P/33	16/37	17/41	18/45
05	16/08	17/12	18/16	19/20	20/24	P/29	16/33	17/37	18/41	19/45
06	17/08	18/12	19/16	20/20	P/25	16/29	17/33	18/37	19/41	20/45
07	18/08	19/12	20/16	P/21	16/25	17/29	18/33	19/37	20/41	P/46
08	19/08	20/12	P/17	16/21	17/25	18/29	19/33	20/37	P/42	16/46
09	20/08	P/13	16/17	17/21	18/25	19/29	20/33	P/38	16/42	17/46
10	P/09	16/13	17/17	18/21	19/25	20/29	P/34	16/38	17/42	18/46
11	16/09	17/13	18/17	19/21	20/25	P/30	16/34	17/38	18/42	19/46
12	17/09	18/13	19/17	20/21	P/26	16/30	17/34	18/38	19/42	20/46
13	18/09	19/13	20/17	P/22	16/26	17/30	18/34	19/38	20/42	P/47
14	19/09	20/13	P/18	16/22	17/26	18/30	19/34	20/38	P/43	16/47
15	20/09	P/14	16/18	17/22	18/26	19/30	20/34	P/39	16/43	17/47
16	P/10	16/14	17/18	18/22	19/26	20/30	P/35	16/39	17/43	18/47
17	16/10	17/14	18/18	19/22	20/26	P/31	16/35	17/39	18/43	19/47
18	17/10	18/14	19/18	20/22	P/27	16/31	17/35	18/39	19/43	20/47
19	18/10	19/14	20/18	P/23	16/27	17/31	18/35	19/39	20/43	P/48
20	19/10	20/14	P/19	16/23	17/27	18/31	19/35	20/39	P/44	16/48

21	20/10	P/15	16/19	17/23	18/27	19/31	20/35	P/40	16/44	17/48
22	P/11	16/15	17/19	18/23	19/27	20/31	P/36	16/40	17/44	18/48
23	16/11	17/15	18/19	19/23	20/27	P/32	16/36	17/40	18/44	19/48
24	17/11	18/15	19/19	20/23	P/28	16/32	17/36	18/40	19/44	20/48
25	18/11	19/15	20/19	P/24	16/28	17/32	18/36	19/40	20/44	P/49
Word Number	**Minor Frame**									
	41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
01	16/49	17/53	18/57	19/61	20/65	P/70	16/74	17/78	18/82	19/86
02	17/49	18/53	19/57	20/61	P/66	16/70	17/74	18/78	19/82	20/86
03	18/49	19/53	20/57	P/62	16/66	17/70	18/74	19/78	20/82	P/87
04	19/49	20/53	P/58	16/62	17/66	18/70	19/74	20/78	P/83	16/87
05	20/49	P/54	16/58	17/62	18/66	19/70	20/74	P/79	16/83	17/87
06	P/50	16/54	17/58	18/62	19/66	20/70	P/75	16/79	17/83	18/87
07	16/50	17/54	18/58	19/62	20/66	P/71	16/75	17/79	18/83	19/87
08	17/50	18/54	19/58	20/62	P/67	16/71	17/75	18/79	19/83	20/87
09	18/50	19/54	20/58	P/63	16/67	17/71	18/75	19/79	20/83	P/88
10	19/50	20/54	P/59	16/63	17/67	18/71	19/75	20/79	P/84	16/88
11	20/50	P/55	16/59	17/63	18/67	19/71	20/75	P/80	16/84	17/88
12	P/51	16/55	17/59	18/63	19/67	20/71	P/76	16/80	17/84	18/88
13	16/51	17/55	18/59	19/63	20/67	P/72	16/76	17/80	18/84	19/88
14	17/51	18/55	19/59	20/63	P/68	16/72	17/76	18/80	19/84	20/88
15	18/51	19/55	20/59	P/64	16/68	17/72	18/76	19/80	20/84	P/89
16	19/51	20/55	P/60	16/64	17/68	18/72	19/76	20/80	P/85	16/89
17	20/51	P/56	16/60	17/64	18/68	19/72	20/76	P/81	16/85	17/89
18	P/52	16/56	17/60	18/64	19/68	20/72	P/77	16/81	17/85	18/89
19	16/52	17/56	18/60	19/64	20/68	P/73	16/77	17/81	18/85	19/89

20	17/52	18/56	19/60	20/64	P/69	16/73	17/77	18/81	19/85	20/89
21	18/52	19/56	20/60	P/65	16/69	17/73	18/77	19/81	20/85	P/90
22	19/52	20/56	P/61	16/65	17/69	18/73	19/77	20/81	P/86	16/90
23	20/52	P/57	16/61	17/65	18/69	19/73	20/77	P/82	16/86	17/90
24	P/53	16/57	17/61	18/65	19/69	20/73	P/78	16/82	17/86	18/90
25	16/53	17/57	18/61	19/65	20/69	P/74	16/78	17/82	18/86	19/90
Word Number	**Minor Frame**									
	51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
01	20/90	A25	20/S4	SP1	TST09	17/03	18/07	19/11	20/15	P/20
02	A01	A26	P/T1	SP2	TST10	18/03	19/07	20/11	P/16	16/20
03	A02	P/S1	16/T1	SP3	TST11	19/03	20/07	P/12	16/16	17/20
04	A03	16/S1	17/T1	SP4	TST12	20/03	P/08	16/12	17/16	18/20
05	A04	17/S1	18/T1	SP5	TST13	P/04	16/08	17/12	18/16	19/20
06	A05	18/S1	19/T1	SP6	TST14	16/04	17/08	18/12	19/16	20/20
07	A06	19/S1	20/T1	SP7	TST15	17/04	18/08	19/12	20/16	P/21
08	A07	20/S1	P/T2	SP8	TST16	18/04	19/08	20/12	P/17	16/21
09	A08	P/S2	16/T2	SP9	TST17	19/04	20/08	P/13	16/17	17/21
10	A09	16/S2	17/T2	SP10	TST18	20/04	P/09	16/13	17/17	18/21
11	A10	17/S2	18/T2	SP11	TST19	P/05	16/09	17/13	18/17	19/21
12	A11	18/S2	19/T2	SP12	P/01	16/05	17/09	18/13	19/17	20/21
13	A12	19/S2	20/T2	SP13	16/01	17/05	18/09	19/13	20/17	P/22
14	A13	20/S2	P/T3	SP14	17/01	18/05	19/09	20/13	P/18	16/22
15	A14	P/S3	16/T3	SP15	18/01	19/05	20/09	P/14	16/18	17/22
16	A15	16/S3	17/T3	SP16	19/01	20/05	P/10	16/14	17/18	18/22
17	A16	17/S3	18/T3	SP17	20/01	P/06	16/10	17/14	18/18	19/22
18	A17	18/S3	19/T3	TST01	P/02	16/06	17/10	18/14	19/18	20/22

19	A18	19/S3	20/T3	TST02	16/02	17/06	18/10	19/14	20/18	P/23
20	A19	20/S3	P/T4	TST03	17/02	18/06	19/10	20/14	P/19	16/23
21	A20	P/S4	16/T4	TST04	18/02	19/06	20/10	P/15	16/19	17/23
22	A21	16/S4	17/T4	TST05	19/02	20/06	P/11	16/15	17/19	18/23
23	A22	17/S4	18/T4	TST06	20/02	P/07	16/11	17/15	18/19	19/23
24	A23	18/S4	19/T4	TST07	P/03	16/07	17/11	18/15	19/19	20/23
25	A24	19/S4	20/T4	TST08	16/03	17/07	18/11	19/15	20/19	P/24
Word Number	**Minor Frame**									
	61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
01	16/24	17/28	18/32	19/36	20/40	P/45	16/49	17/53	18/57	19/61
02	17/24	18/28	19/32	20/36	P/41	16/45	17/49	18/53	19/57	20/61
03	18/24	19/28	20/32	P/37	16/41	17/45	18/49	19/53	20/57	P/62
04	19/24	20/28	P/33	16/37	17/41	18/45	19/49	20/53	P/58	16/62
05	20/24	P/29	16/33	17/37	18/41	19/45	20/49	P/54	16/58	17/62
06	P/25	16/29	17/33	18/37	19/41	20/45	P/50	16/54	17/58	18/62
07	16/25	17/29	18/33	19/37	20/41	P/46	16/50	17/54	18/58	19/62
08	17/25	18/29	19/33	20/37	P/42	16/46	17/50	18/54	19/58	20/62
09	18/25	19/29	20/33	P/38	16/42	17/46	18/50	19/54	20/58	P/63
10	19/25	20/29	P/34	16/38	17/42	18/46	19/50	20/54	P/59	16/63
11	20/25	P/30	16/34	17/38	18/42	19/46	20/50	P/55	16/59	17/63
12	P/26	16/30	17/34	18/38	19/42	20/46	P/51	16/55	17/59	18/63
13	16/26	17/30	18/34	19/38	20/42	P/47	16/51	17/55	18/59	19/63
14	17/26	18/30	19/34	20/38	P/43	16/47	17/51	18/55	19/59	20/63
15	18/26	19/30	20/34	P/39	16/43	17/47	18/51	19/55	20/59	P/64
16	19/26	20/30	P/35	16/39	17/43	18/47	19/51	20/55	P/60	16/64
17	20/26	P/31	16/35	17/39	18/43	19/47	20/51	P/56	16/60	17/64

18	P/27	16/31	17/35	18/39	19/43	20/47	P/52	16/56	17/60	18/64
19	16/27	17/31	18/35	19/39	20/43	P/48	16/52	17/56	18/60	19/64
20	17/27	18/31	19/35	20/39	P/44	16/48	17/52	18/56	19/60	20/64
21	18/27	19/31	20/35	P/40	16/44	17/48	18/52	19/56	20/60	P/65
22	19/27	20/31	P/36	16/40	17/44	18/48	19/52	20/56	P/61	16/65
23	20/27	P/32	16/36	17/40	18/44	19/48	20/52	P/57	16/61	17/65
24	P/28	16/32	17/36	18/40	19/44	20/48	P/53	16/57	17/61	18/65
25	16/28	17/32	18/36	19/40	20/44	P/49	16/53	17/57	18/61	19/65
Word Number	**Minor Frame**									
	71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
01	20/65	P/70	16/74	17/78	18/82	19/86	20/90	A25	20/S4	Blank
02	P/66	16/70	17/74	18/78	19/82	20/86	A01	A26	P/T1	
03	16/66	17/70	18/74	19/78	20/82	P/87	A02	P/S1	16/T1	
04	17/66	18/70	19/74	20/78	P/83	16/87	A03	16/S1	17/T1	
05	18/66	19/70	20/74	P/79	16/83	17/87	A04	17/S1	18/T1	
06	19/66	20/70	P/75	16/79	17/83	18/87	A05	18/S1	19/T1	
07	20/66	P/71	16/75	17/79	18/83	19/87	A06	19/S1	20/T1	
08	P/67	16/71	17/75	18/79	19/83	20/87	A07	20/S1	P/T2	
09	16/67	17/71	18/75	19/79	20/83	P/88	A08	P/S2	16/T2	
10	17/67	18/71	19/75	20/79	P/84	16/88	A09	16/S2	17/T2	
11	18/67	19/71	20/75	P/80	16/84	17/88	A10	17/S2	18/T2	
12	19/67	20/71	P/76	16/80	17/84	18/88	A11	18/S2	19/T2	
13	20/67	P/72	16/76	17/80	18/84	19/88	A12	19/S2	20/T2	
14	P/68	16/72	17/76	18/80	19/84	20/88	A13	20/S2	P/T3	
15	16/68	17/72	18/76	19/80	20/84	P/89	A14	P/S3	16/T3	
16	17/68	18/72	19/76	20/80	P/85	16/89	A15	16/S3	17/T3	

17	18/68	19/72	20/76	P/81	16/85	17/89	A16	17/S3	18/T3	
18	19/68	20/72	P/77	16/81	17/85	18/89	A17	18/S3	19/T3	
19	20/68	P/73	16/77	17/81	18/85	19/89	A18	19/S3	20/T3	
20	P/69	16/73	17/77	18/81	19/85	20/89	A19	20/S3	P/T4	
21	16/69	17/73	18/77	19/81	20/85	P/90	A20	P/S4	16/T4	
22	17/69	18/73	19/77	20/81	P/86	16/90	A21	16/S4	17/T4	
23	18/69	19/73	20/77	P/82	16/86	17/90	A22	17/S4	18/T4	
24	19/69	20/73	P/78	16/82	17/86	18/90	A23	18/S4	19/T4	
25	20/69	P/74	16/78	17/82	18/86	19/90	A24	19/S4	20/T4	

NOTES ON THE PREVIOUS TABLES:

1) The format consists of minor frames (1 to 80). Minor frames 1 and 80 are blank. This means that no data is available in the PEU output FIFO for reading by the AIP and therefore the AIP should not send any sample pulses to AMSU-B during these minor frame periods.

2) Table 4.1.4.3-2 indicates the meanings for the variables used in Table 4.1.4.3-1:

Table 4.1.4.3-2. Meaning of Variables in Table 4.1.4.3-1.

Key	Meaning
SP	Spare word (Data is 5555H except for spare words 34 to 36)
TSTxx	Test Data
P/n	Shaft position at mid-integration time for FOV n.
16/n	Integrated output for channel 16 for FOV n.
17/n	Integrated output for channel 17 for FOV n.
18/n	Integrated output for channel 18 for FOV n.
19/n	Integrated output for channel 19 for FOV n.
20/n	Integrated output for channel 20 for FOV n.
/Sn	Space view FOV n.
/Tn	Internal Target view FOV n.

AXX	Multiplexed Housekeeping data.

3) The format structure and definition is identical for all modes. In scanning modes, n, Sn and Tn represent pixel identification. In static modes, n, Sn and Tn have no meaning; all data values relate to the IFOV.

4.1.5 AIP MINOR FRAME FORMATS

The spacecraft's AMSU Instrument Processor (AIP) collects digital data from the AMSU-A and AMSU-B sensors. This data consists of earth view pixel data, housekeeping data and space and blackbody view data. Table 4.1.5-1 contains the AIP Minor Frame Format.

Table 4.1.5-1. AIP Minor Frame Format.			
Function	**No. of Words**	**Word Position**	**Bit No. 1 2 3 4 5 6 7 8 Plus Word Code & Meaning**
Frame Sync	3	0	1 1 1 1 0 0 1 1 Frame sync is first 22 bits. Last 2 bits of word 2 are: 00
		1	0 1 1 0 1 0 1 1
		2	0 0 0 0 0 0 0 0
Spare	1	3	0 1 0 1 0 1 0 1
Minor Frame Counter	1	4	0 0 0 0 0 0 0 0 Represents minor frame 0
			0 1 0 0 1 1 1 1 Represents minor frame 79
			MSB is first.
Major frame Counter	1	5	First six bits are 000000. Last 2 bits are major (8 sec) frame counter. The major frame counter is incremented every 80 minor frames. Bits 7 and 8 of minor frame 5 will count 8-second intervals, the count overflowing to 0 synchronous with the TIP 32-second major frame pulse.
Spare	2	6	0 1 0 1 0 1 0 1
		7	0 1 0 1 0 1 0 1
AMSU-A1	26	8 thru 33	8 Bit words are formed by the AMSU-A1 experiment and are read out by the AMSU Information Processor at an average rate of 260 words per second.
AMSU-A2	14	34 thru 47	8 Bit words are formed by the AMSU-A2 experiment and are read out by the AMSU Information Processor at an average rate of 140 words per second.
AMSU-B	50	48 thru 97	8 Bit words are formed by the AMSU-B experiment and are read out by the AMSU Information Processor at an average rate of 500 words per second.
Spare	4	98 thru 101	0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 . . . . .
AMSU Parity	1	102	Bit 1: 0
			Bit 2: 1
			Bit 3: Even parity check words 2 thru 18
			Bit 4: Even parity check words 19 thru 35
			Bit 5: Even parity check words 36 thru 52

			Bit 6: Even parity check words 53 thru 69
			Bit 7: Even parity check words 70 thru 86
			Bit 8: Even parity check words 87 thru Bit 7 of word 102
TIP Data	104	103 thru 206	Identical to TIP minor frame format in Table 4.3.4.3.1-7.
TIP Parity	1	207	Bit 1: 0
			Bit 2: 1
			Bit 3: Even parity check words 105 thru 121
			Bit 4: Even parity check words 122 thru 138
			Bit 5: Even parity check words 139 thru 155
			Bit 6: Even parity check words 156 thru 172
			Bit 7: Even parity check words 173 thru 189
			Bit 8: Even parity check words 190 thru Bit 7 of word 206
			This parity word amounts to an AIP recalculation of the TIP parity which was calculated by the TIP in TIP word 103 (AIP word 206).

4.2 APT SYSTEM

4.2.1 GENERAL

The Automatic Picture Transmission (APT) system provides a reduced resolution data stream from the AVHRR/3 instrument. Any two of the AVHRR channels can be chosen by ground command for processing and ultimate output to the APT transmitter. A visible channel is used to provide visible APT imagery during daylight, and one IR channel is used constantly (day and night). A second IR channel can be scheduled to replace the visible channel during the nighttime portion of the orbit. The analog APT signal is transmitted continuously and can be received in real time by relatively unsophisticated, inexpensive ground station equipment (a list of equipment manufacturers is available on the NOAASIS Internet site, or by mail. See Internet resources in Appendix E) while the satellite is within radio range. The characteristics of the transmitted signal remain unchanged in the NOAA KLM satellite series from those in the TIROS-N series (NOAA-8 through NOAA-14), while there is a minor change in the data format to account for the modified channel 3 on the AVHRR instrument.

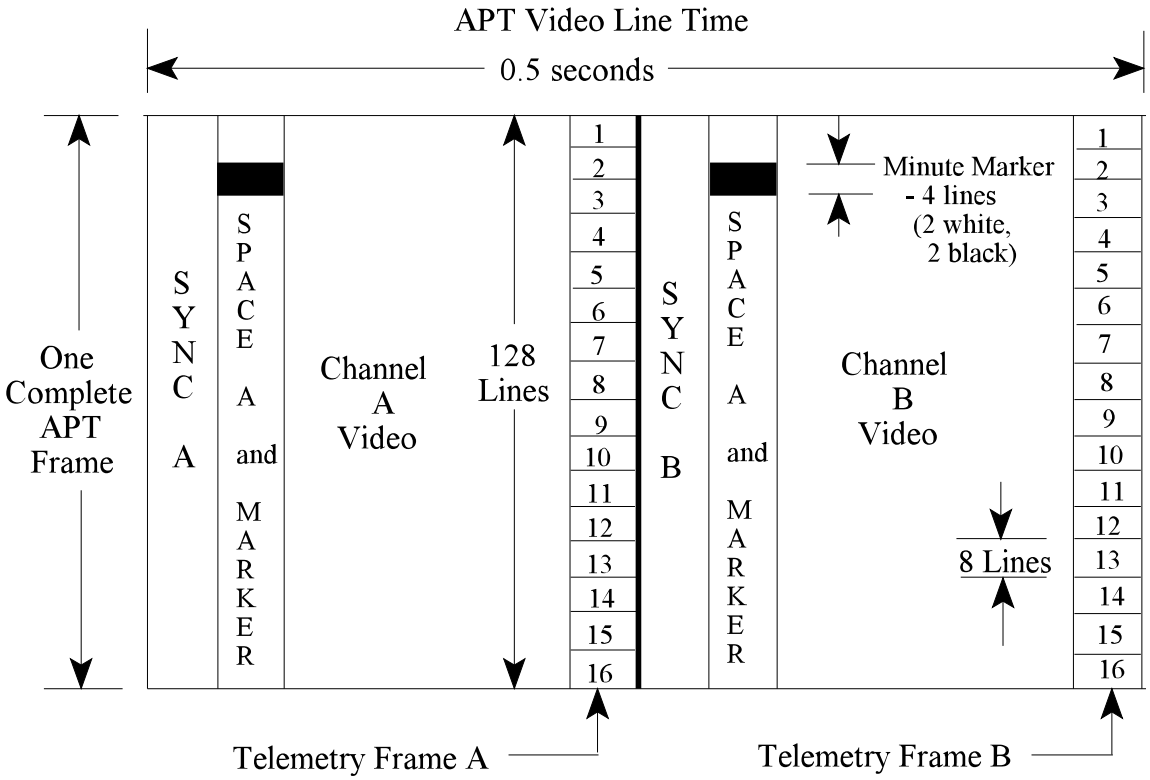
4.2.2 APT TRANSMISSION CHARACTERISTICS

The processed AVHRR instrument data AM modulates a 2400 Hz subcarrier. The maximum subcarrier modulation is defined as the amplitude of the gray scale wedge number 8 (see Figure 4.2.2-1), producing a modulation index of 87% ±5% (not exceeding 92%). The AM modulated subcarrier is subsequently used to FM modulate the VTX transmitter operating in the 137 - 138 MHz band. Table 4.2.2-1 summarizes the pertinent APT transmission characteristics.

Table 4.2.2-1. APT Transmission Characteristics.

Line Rate	120 lines/min
Data Channels	2 transmitted 6 available
Data Resolution	4.0 km
Carrier Modulation	2.4 KHz AM subcarrier on FM carrier
Transmitter Frequency (MHz)	137.50 or 137.62
Transmitter Power (EOL)	5 W (37dBm)
Radiated Power (dBm, @ 63 degrees)	36.7
Polarization	RCP

Figure 4.2.2-1. APT Frame Format.



WEDGE #1	WEDGE #2	WEDGE #3	WEDGE #4	WEDGE #5	WEDGE #6	WEDGE #7	WEDGE #8
1	2	3	4	5	6	7	8
Zero Modulation Reference	Thermistor Temp. #1	Thermistor Temp. #2	Thermistor Temp. #3	Thermistor Temp. #4	Patch Temp.	Back Scan	Channel I.D. Wedge
9	10	11	12	13	14	15	16

Notes:
1) Each telemetry frames consists of 16 points
2) Telemetry frame rate is 1 frame per 84 seconds
3) Each telemetry point is repeated on 8 successive APT video lines

4.2.3 APT DATA FRAME FORMAT

The MIRP processes the AVHRR data and outputs the APT format (simultaneously with the HRPT, LAC and GAC formats). All the processing in the MIRP is done in the digital realm. The digitized AVHRR input consists of 10-bit words. The MIRP inserts calibration and telemetry data for each of the selected APT channels being transmitted, and AM modulates the 2400 Hz subcarrier, corresponding to the light and dark areas seen by the instrument, with the 8 Most Significant Bits (MSB) of the 10-bit data. The formatted data passes through the MIRP digital-to-analog converter, is filtered and modulated onto the 2400 Hz carrier.

On the NOAA KLM series, two of the six possible AVHRR spectral channels are multiplexed so that channel A APT data is obtained from one spectral channel of the first AVHRR scan line, and channel B from another spectral channel contained in the second AVHRR scan line. The third AVHRR scan line is omitted from the APT, and the process is then repeated. It can be seen that the data processing algorithm is designed so that data from every third line from each of the two selected channels of the original high resolution AVHRR output are formatted for each of the two APT channels. The algorithm also maintains nearly equal geometric resolution of 4 km along the scan line. This is accomplished by using a separate resolution reduction in each of five regions or zones either side of the nadir. The details of this algorithm is shown in Table 4.2.3-1 and Figure 4.2.3-1. The two AVHRR channels used are identified in the daily TBUS message, and are further classified by the daytime and nighttime portion of the orbit. Channel identification is also included as part of the telemetry frame.

Table 4.2.3-2 enumerates the APT format parameters. Figures 4.2.2-1, 4.2.3-2, and 4.2.3-3 illustrate the APT frame format, the video line format and signal synchronization details. Examining the frame format shown in Figure 4.2.2-1, it can be seen that both channel A and B have a series of 16 "wedges" used in calibrating the APT image. Each of the wedges is composed of eight successive video lines. Only the wedges of one frame from an entire, received pass, are needed for calibration. Also note that wedges 1 through 14 are identical on the images from both channels A and B. Only wedges 15 (the back scan value when one of the IR radiometers "looks" at a black body radiator) and 16 (channel identification) vary between channel A and B.

The channel identification wedge has changed in the NOAA KLM series now that there are six possible channels 1, 2, 3A, 3B, 4 or 5. The modulation index of wedge 16 will equal one of the first six grey scale wedges. Wedge 3 will correspond to channel 3A being in use, while wedge 6 will correspond to channel 3B being in use. All other channel numbers will be the same as the number of the corresponding grey scale wedge.

Table 4.2.3-1. APT Linearization Algorithm.			
Zone 1 0 -16.98 degrees from nadir	average 4 contiguous samples	628 AVHRR data samples per channel	157 processed APT words output to D/A converter
Zone 2 16.98 - 34.83 degrees either side of nadir	average 3 contiguous samples, skip 1, repeat	330 AVHRR data samples per channel	110 processed APT words output to D/A converter
Zone 3 34.83 - 43.83 degrees either side of nadir	average 2 contiguous samples	166 AVHRR data samples per channel	83 processed APT words output to D/A converter
Zone 4 43.83 - 48.84 degrees either side of nadir	average 1.5 samples (A+B/2 and B+C/2)	93 AVHRR data samples per channel	62 processed APT words output to D/A converter
Zone 5 48.84 - 55.4 degrees either side of nadir	retain original resolution	121 AVHRR data samples per channel	121 processed APT words output to D/A converter

Figure 4.2.3-1. APT Linearization.

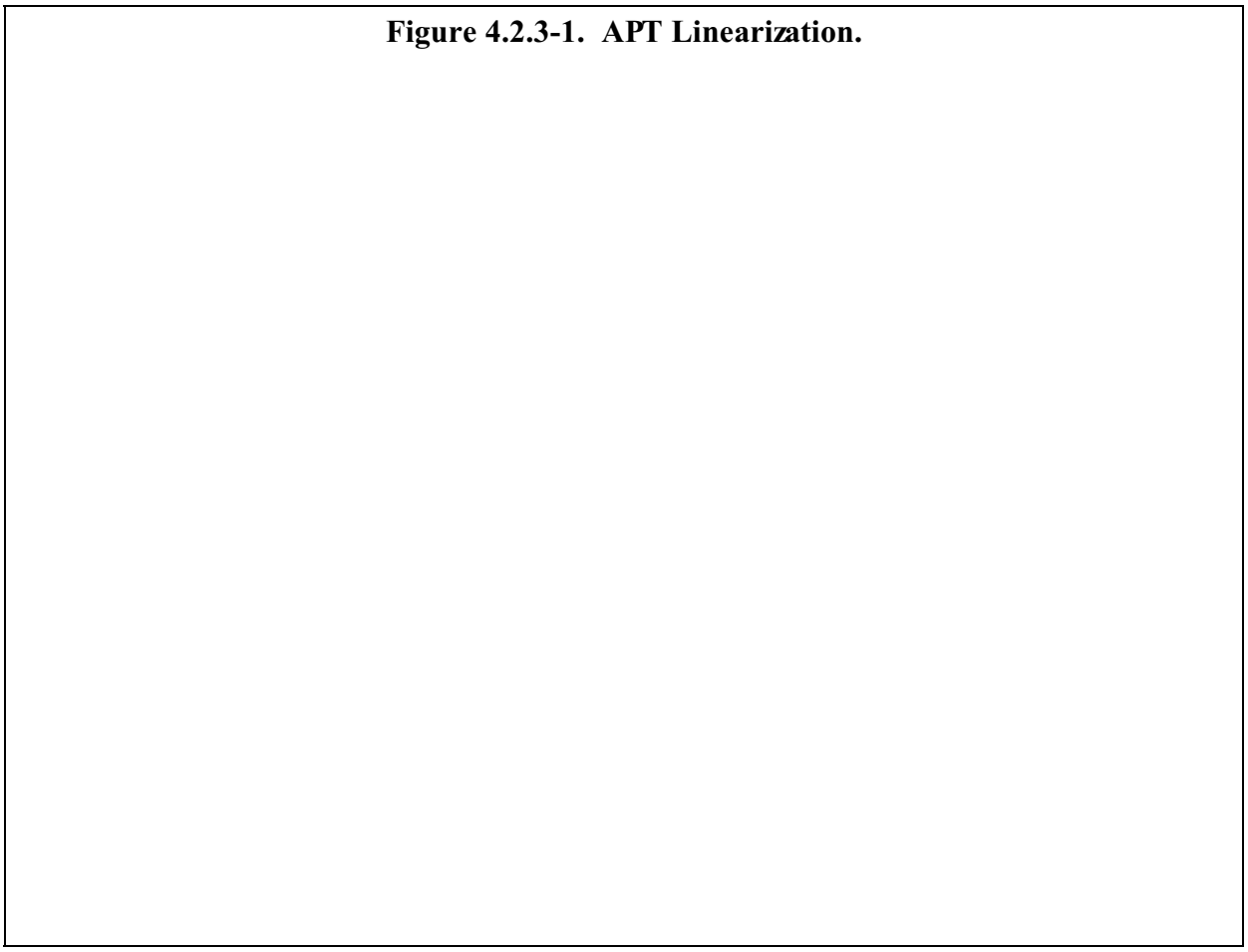
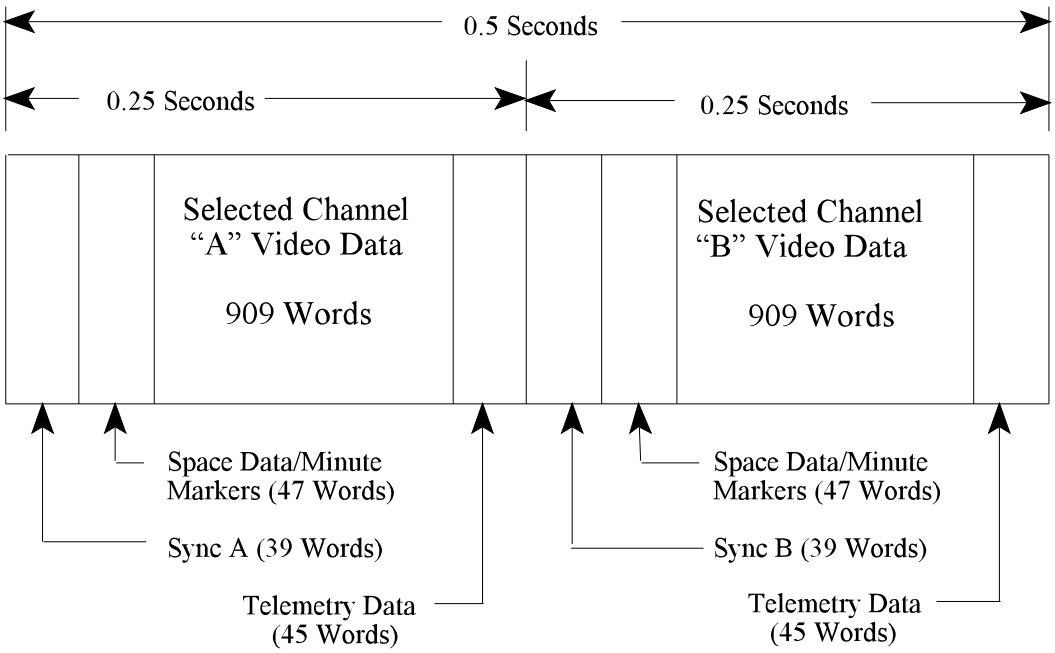


Table 4.2.3-2. APT Parameters.	
Frame	
Rate	1 frame/64 secs
Length	128 lines
Format	See Table 4.2.3-2
Line Parameters	
Rate	2 lines/sec
Number of words	2080
Number of sensor channels	2
Number of words/sensor channel	909
Format	See Figure 4.2.3-1

Line sync format	See Figures 4.2.3-2 and 4.2.3-3
Word parameters	
Rate	4160 words/sec
D/A conversion accuracy	8 MSB's of each 10 bit word

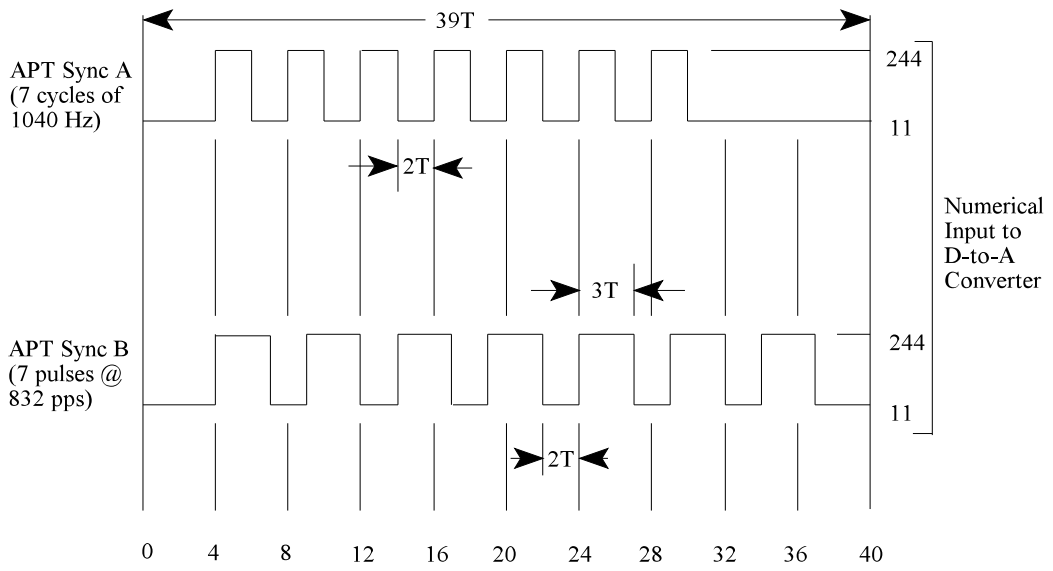
Figure 4.2.3-2. APT Video Line Format.



Notes:

1) Equivalent output digital data rate is 4160 words/second
2) Video line rate - 2 lines/second
3) APT frame size - 128 lines
4) Any two of the five (six for group 505) AVHRR channels may be selected for use
5) Sync A is a 1040-Hz square wave - 7 cycles
6) Sync B is an 832-pps pulse train - 7 pulses
7) Each of the 16 telemetry points is repeated on 8 successive lines
8) Minute markers are repeated on 4 successive lines, with 2 lines black and 2 lines white

Figure 4.2.3-3. APT Synchronization details.



Notes:

1) T=1/4160 second
2) Sync A precedes Channel A data
3) Sync B precedes Channel B data

4.3 DIRECT SOUNDER BROADCAST (DSB)

4.3.1 GENERAL

The direct sounder broadcast (also referred to as the beacon transmission) contains the low bit rate instrument (HIRS/3, SBUV/2, SEM, and DCS/2, but not AMSU) digital data, identical to that within the HRPT transmission. Data are therefore available in both the VHF and S-band links. Those users receiving the high resolution HRPT transmission would likely find it most desirable to extract the low rate data from this data stream. The VHF beacon transmission is available to users who do not intend to install the more complex equipment necessary to receive high data rate S-band service. The lower data rates permit the user to install less complex, less costly equipment to receive the data without degrading its quality.

4.3.2 DSB TRANSMISSION CHARACTERISTICS

On board the satellite, output from the low data rate instruments is collected and formatted by the TIROS Information Processor (TIP). Parallel outputs are provided for the real-time VHF beacon transmission (DSB) and the MIRP (for the HRPT service). The instrument data is multiplexed with analog and digital housekeeping data. The TIP output directly modulates the beacon transmission. The data is transmitted as a 8.32 Kbps split phase signal (similar to the HRPT transmission, above) over one of the beacon transmitters (BTX). Detailed transmission characteristics and TIP parameters are shown in Tables 4.3.2-1 and 4.3.2-2.

Table 4.3.2-1. DSB Transmission Characteristics.

Carrier Modulation	Digital split phase, phase modulated
Transmitter Frequency (MHz)	137.35 or 137.77
Transmitter Power (EOL)	1.0 W (30 dBm)
Radiated Power (dBm)	≥ 9.5 (over 90% of sphere)
Polarization	RCP

Table 4.3.2-2. TIP Parameters.

Major Frame	
Rate	1 major frame/32 sec
Minor Frames/Major Frame	320
Minor Frame	
Rate	10 minor frames/sec

Number of words	11090
Format	See Table 4.3.4.3.1-7
Word Parameters	
Rate	1040 words/sec
Number of bits/word	8
Order	Bit 1=MSB, Bit 8=LSB
Bit Parameters	
Rate	8320 bits/sec
Format	Split phase
Data "0"	-67/+67 degrees
Data "1"	+67/-67 degrees

4.3.3 TIP FRAME FORMAT

The TIP format is based on a major frame which contains 320 minor frames. About one-quarter of the 104 telemetry word locations in the TIP minor frame have been changed for NOAA KLM. This is due to the removal of the Stratospheric Sounding Unit (SSU) and Earth Radiation Budget Experiment (ERBE) from the new series of spacecraft. Word locations previously assigned to the SSU have been allocated to the HIRS/3 and Data Collection System (DCS). The ERBE word locations have been reassigned to DCS, as well. In addition, two words have been allocated to the Decryption Authentication Unit (DAU). Figure 4.3.3-1 shows the telemetry word location in the frame format, and Table 4.3.3-1 contains telemetry word titles, locations within the frame, and word descriptions in tabular form.

Table 4.3.3-1. TIP Orbit Mode.

0 1 2	3 4 5	6 7	8	9	10	11
4-BIT | - 20-BIT SYNCH - - -| S/C ID 11101101 1110001 0000	STATUS, DWELL MODE ADDRESS, MINOR FRAME COUNTER	CMD VERIFI-CATION DATA	DIG-B SUB-COM-1	ANALOG SUBCOM (32 SEC)	ANALOG SUBCOM (16 SEC)	ANALOG SUBCOM (1 SEC)

12 DIG-B SUB-COM-2	13 ANA-LOG SUB-COM (16 SEC)	14 DAU-1	15 DAU-2	16 HIRS/3	17 HIRS/3	18 DCS-2	19 DCS-2	20 SEM	21 SEM	22 HIRS/3	23 HIRS/3
24 DCS-2	25 DCS-2	26 HIRS/3	27 HIRS/3	28 DCS-2	29 DCS-2	30 HIRS/3	31 HIRS/3	32 DCS-2	33 DCS-2	34 HIRS/3	35 HIRS/3
36 SBUV/2	37 SBUV/2	38 HIRS/3	39 HIRS/3	40 DCS-2	41 DCS-2	42 HIRS/3	43 HIRS/3	44 DCS-2	45 DCS-2	46 47 CPU-A TELEMETRY	
48 49 50 51 - - - CPU-A TELEMETRY - - - -				52 DCS-2	53 DCS-2	54 HIRS/3	55 HIRS/3	56 DCS-2	57 DCS-2	58 HIRS/3	59 HIRS/3
60 DCS-2	61 DCS-2	62 HIRS/3	63 HIRS/3	64 DCS-2	65 DCS-2	66 HIRS/3	67 HIRS/3	68 DCS-2	69 DCS-2	70 HIRS/3	71 HIRS/3
72 DCS-2	73 DCS-2	74 HIRS/3	75 HIRS/3	76 DCS-2	77 DCS-2	78 HIRS/3	79 HIRS/3	80 SBUV/2	81 SBUV/2	82 HIRS/3	83 HIRS/3
84 HIRS/3	85 HIRS/3	86 DCS-2	87 DCS-2	88 HIRS/3	89 HIRS/3	90 DCS-2	91 DCS-2	92 HIRS/3	93 HIRS/3	94 DCS-2	95 DCS-2
96 97 98 99 100 101 - - - - - - - - CPU-B TELEMETRY - - - - - - - - - -						102 SPARE 01010101	103 6-BITS EVEN PAR-ITY	MINOR FRAME PERIOD - 0.1 SEC MAJOR FRAME PERIOD - 32 SEC OUTPUT DATA RATE - 8.320 KBPS			

Note: Number in upper left corner indicates minor frame word number.

4.3.4 DIGITAL "A" TELEMETRY

4.3.4.1 HIRS/3

The data from the HIRS/3 are provided to the TIP system from a storage register. The TIP clock pulse (C_1) and Data Select pulses determine the time at which data are called out. The TIP formatter calls out groups of 8-bit words in a sequence that multiplexes HIRS/3 data with that of other instruments. Because of the large quantity of HIRS/3 data to be transmitted and the use of 13-bit decoding of radiometric data, it was not possible to format the HIRS/3 data into neat 8-bit segments. The HIRS/3 data are therefore provided as a continuous stream with 13-bit word lengths. During any minor frame, there are 288 bits of data; each bit is identified as to its purpose.

A full set of HIRS/3 operational data, including command status monitors, housekeeping information and radiance data of the 20 channels, is contained in the Digital "A" output. The HIRS/3 data repeats every 6.4 seconds as described below. The 6.4 second period contains 64 elements.

1) Element Definition

Digital "A" output is divided into "elements" of 288 bits. An element is phased to fit into a TIP minor frame as described above.

2) Element Formats

Sixty-four elements make up each scan. The formats for the elements repeat every 6.4 seconds and correspond to the particular parts of the scan. Element numbers 0-55 are Earth scan data. Scan element 0 describes the data at the time of viewing the first Earth scan position. Scan element 55 designates the last Earth scan position. Scan elements 56-63 occur during retrace during normal Earth scanning. The same element number designations continue when the scan is commanded to a calibration target. Normally the mirror motion to the warm calibration target takes place during the normal retrace interval. In the case of slew to the space look position, the motion occurs during scan elements 0 to 7.

Data reduction must take this into account as required. The elements are divided as follows:

(a) Bits 1-26

Two 13 bit words have the same function in all 64 elements. The function assembled in these words are as follows:

Word 1	Function	Range (Decimal)
1-8	Scan Encoder Position	0 to 199
9-13	Electronic Cal Level Indicator	0 to 331
Word 2	**Function**	**Range (Decimal)**
1-6	Channel 1 Period Monitor	0 to 63
7-12	Element Number	0 to 63
13	Filter Sync Designator	n/a

(b) Bits 27-286

This group of bits is divided into 20 13-bit words (20 Ch x 13 Bits). For elements 0-55, these are the Radiant Signal Output. The word functions are dependent on element number. These functions are given in Figure 4.3.4.1-1. Except for the two status words in element 63, all words are quantity where bit 1 is the sign bit and bits 2 through 13 are amplitude (0 to 4095). Bit 2 is the most significant bit (MSB) and bit 13 is the least significant bit (LSB) of the quantity. The sign bit is: logic "1" is + (positive) and logic "0" is - (negative).

The HIRS/3 instrument serial number is preset for each instrument in element 63, bits 42-44. The protoflight has the designation 001; the flight models will be designated 002 on up.

(c) Bits 287 and 288

In the same manner as for bits 1 through 26, these two bits have the same function in all 64 elements. In order to aid determination of times when data should not be used, we have included a Valid Data Bit into the data stream. This bit is a "1" when all conditions are normal and data may be considered good. It will be a "0" when the scan system is in a slew mode or when the filter wheel is not synchronized to the timing system.

Bit 287Valid Data Bit

logic "1" Valid Data
logic "0" Ignore Radiometric Data

Minor Word Parity Check is a bit inserted to make the total word odd. This permits automatic checking for data losses in the transmission of the data from the

HIRS/3.

Bit 288Odd bit parity

3) Function Descriptions

Scan Encoder Position - Encoder position is the sensed position of the scan mirror in 1.8 degree increments. The scan positions are described later, but it may be noted that encoder position "1" occurs at the first Earth scan position, hence will be the encoder position noted during element "0".

Electronic Cal Level Indicator - Electronic calibration level advances from 0 to 31, defining the step level measured in each radiometric channel during elements 56 and 57. Since both a positive and negative calibration is made at the end of each scan line, the level applies to both. The step level starts at 0 on the first scan after a calibration start pulse and continues repetitively after that and even when calibration is disabled.

Channel 1 Period Monitor - Measures the variation in time interval of a segment of the filter wheel on each rotation. The reading measures 1.248 MHz clock intervals of that segment; hence, it defines velocity variations to a granularity of 0.8 microseconds. This is a diagnostic output and is not used in system data processing or evaluation.

Element Number - The number of this data group. It advances from 0 to 63 with element 0 related to the first Earth scan position. The element number repeats regardless of scan position or mode.

Filter Sync Designator - Filter Sync is a "1" when the filter wheel is in synchronization with the timing system. This is diagnostic data not normally used in data collection or processing.

Table 4.3.4.1-1. Digital "A" Status Telemetry.

Element Number	Bit Number	Function	Remarks
0-55	27-39	Radiometric Channel No. 1 (669 cm^{-1})	0 counts radiance from scene equal radiance from filter wheel (FW). Plus (+) values are warmer than FW.
	40-52	Radiometric Channel No.17 (2360 cm^{-1})	0 counts offset from FW radiance. Plus and minus are warmer and cooler than offset.
	53-65	Radiometric Channel No. 2 (680 cm^{-1})	No offset.

	66-78	Radiometric Channel No. 3 (690 cm^{-1})	No offset.
	79-91	Radiometric Channel No. 13 (2190 cm^{-1})	Offset.
	92-104	Radiometric Channel No. 4 (703 cm^{-1})	No offset.
	105-117	Radiometric Channel No. 18 (2515 cm^{-1})	Offset.
	118-130	Radiometric Channel No. 11 (1365 cm^{-1})	No offset.
	131-145	Radiometric Channel No. 19 (2660 cm^{-1})	Offset.
	144-156	Radiometric Channel No. 7 (749 cm^{-1})	No offset.
	157-169	Radiometric Channel No. 8 (900 cm^{-1})	No offset.
	170-182	Radiometric Channel No. 20 (14,500 cm^{-1})	Black is minus. White is plus.
	183-195	Radiometric Channel No. 10 (1,225 cm^{-1})	No offset.
	196-208	Radiometric Channel No. 14 (2,210 cm^{-1})	Offset.
	209-221	Radiometric Channel No. 6 (733 cm^{-1})	No offset.
	222-234	Radiometric Channel No. 5 (716 cm^{-1})	No offset.
	235-247	Radiometric Channel No. 15 (2,240 cm^{-1})	Offset.
	248-260	Radiometric Channel No. 12 (1,488 cm^{-1})	No offset.
	261-273	Radiometric Channel No. 16 (2,270 cm^{-1})	Offset.

	274-286	Radiometric Channel No. 9 (1,030 cm^{-1})	Offset.
56	27-286	Positive Electronics Calibration. Applied to 20 radiometric channels.	Calibration level advances one of the 32 equal level steps on successive scans. The offset and gain of each channel will influence the amplitude of the signal. The calibration level applied to the electronics channels is indicated.
57	27-286	Negative Electronics Calibration applied to 20 radiometric channels	n/a
58	27-91	Internal Warm Target Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
	92-156	Temperature Sensor #2	Value repeated 5 times. Range 273 to 333 K.
	157-221	Temperature Sensor #3	Value repeated 5 times. Range 273 to 333 K.
	222-286	Temperature Sensor #4	Value repeated 5 times. Range 273 to 333 K.
59	27-91	To be determined.	n/a
	92-156	To be determined.	n/a
	157-221	To be determined.	n/a
	222-286	To be determined.	n/a
60	27-91	Filter Wheel Housing Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
	92-156	Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
	157-221	Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
	222-286	Temperature Sensor #1	Value repeated 5 times. Range 273 to 333 K.
61	27-91	Patch Temperature Expanded Scale	Value repeated 5 times. Range 90 to 150 K.

	92-156	First Stage Radiator Temperature Sensor	Value repeated 5 times. Range 150 to 320 K.
	157-221	Filter Wheel Housing Heater Current	Value repeated 5 times. Range 0 to 500 mA.
	222-286	Electronic Calibration Digital to Analog	Value repeated 5 times. Range volts 0 to 4 V.
62	27-39	Scan Mirror Temperature	Range 260 to 320 K
	40-52	Primary Telescope Temperature	Range 260 to 320 K
	53-65	Secondary Telescope Temperature	Range 260 to 320 K
	66-78	HIRS/3 Baseplate Temperature	Range 260 to 320 K
	79-91	HIRS/3 Electronics Temperature	Range 260 to 320 K
	92-104	Patch Temperature - Full Range	Range 90 to 320 K
	105-117	Scan Motor Temperature	Range 260 to 320 K
	118-130	Filter Wheel Motor Temperature	Range 260 to 320 K
	131-143	Cooler Housing Temperature	Range 260 to 320 K
	144-156	Patch Control Power	Range 0 to 80 mW
	157-169	Scan Motor Current	Range 0.65 to 1.0
	170-182	Filter Motor Current	Range 100 to 300 mA
	183-195	+15 VDC	Range 15 ± 0.2 V
	196-208	-15 VDC	Range -15 ± 0.2 V
	209-221	+7.5 VDC	Range +7.5 ± 0.05 V
	222-234	-7.5 VDC	Range -7.5 ± 0.05 V
	235-247	+10 VDC	Range 10 ± 0.2 V
	248-260	+5 VDC	Range 5 ± 0.2 V

	261-273	Analog Ground	Range ± 1 count
	274-286	Analog Ground	Range ± 1 count
63	27-39	Line Counter (gives the number of lines from the last auto calibration sequence)	0 to 8191 (There is no sign bit used in the line counter). Reset to 0 count is only when counter overflows.
	40-52	First Status Word	First 5 bits are instrument serial number (no sign bit). The remaining bits indicate status as shown in Table 4.3.4.1-2.
	53-65	Second Status Word	First 5 bits are zero filled. The remaining bits indicate status as shown in Table 4.3.2.1-2.
	66-78	Data Verification Binary Code	Binary Code is: (1,1,1,1,1,0,0,1,0,0,0,1,1) Equivalent Base 10 value +3,875
	79-91		Base 10 value +1,443
	92-104		Base 10 value -1,522
	105-117		Base 10 value -1,882
	118-130		Base 10 value -1,631
	131-143		Base 10 value -1,141
	144-156		Base 10 value 1,125
	157-169		Base 10 value 3,655
	170-182		Base 10 value -2,886
	183-195		Base 10 value -3,044
	196-208		Base 10 value -3,764
	209-221		Base 10 value -3,262
	222-234		Base 10 value -2,283
	235-247		Base 10 value -2,251
	248-260		Base 10 value 3,214
	261-273		Base 10 value 1,676

	274-286		Base 10 value 1,992

4) Digital "A" Status Telemetry

The last element of each scan, element 63, contains two status words. Bits 45-52 and 58-65 of element 63 are command status bits. Logic state definition is shown in Table 4.3.4.1-2.

Table 4.3.4.1-2. Digital "A" Status Telemetry (Element 63, Status Words).

Bit Number	Function	Remarks
First Status Word		
45	Instrument ON/OFF	ON=1
46	Scan Motor ON/OFF	ON=0
47	Filter Wheel ON/OFF	ON=0
48	Electronics ON/OFF	ON=1
49	Cooler Heat ON/OFF	ON=0
50	Internal Warm Target Position	True=0
51	Internal Cold Target Position	True=0
52	Space Position	True=0
Second Status Word		
58	Nadir position	True=0
59	Calibration Enable/Disable	Enabled =0
60	Cooler Door Release Enable/Disable	Enabled=0
61	Cooler Door Open	YES=1
62	Cooler Door Closed	YES=1
63	Filter Housing Heat ON/OFF	ON=0
64	Patch Temperature Control ON/OFF	ON=0
65	Filter Motor Power HIGH	Normal=1

4.3.4.2 SEM-2

SEM-2 data accumulation and transfer are synchronized to the spacecraft's 32 second Major Frame. The Major Frame consists of 320 0.1 second Minor Frames, and SEM-2 is assigned two Digital "A" data words (20 and 21) per Minor Frame.

The Digital "A" telemetry format is shown in Table 4.3.4.2-1 which identifies the data assignments for each of the two SEM data words in the 320 Minor Frames constituting one Major Frame.

MEPED Digital "A" data consists of six directional proton measurements and three directional electron measurements for each of two directions of incidence (0 and 90 degrees) and four omni-directional proton measurements. All but the two highest energy omni-directional proton measurements are read out every two seconds. The two highest energy omnidirectional proton measurements are read out every four seconds. The MEPED Digital "A" data and readout rates are summarized in Table 4.3.4.2-2.

TED Digital "A" data consists of a 0.05 to 1 keV partial energy flux measurement, a 1 to 20 keV partial energy flux measurement, maximum differential energy fluxes, four-point differential energy spectra and background measurements for electrons and protons, each at two angles of incidence (0 and 30 degrees). The TED Digital "A" output data and readout rates are summarized in Table 4.3.4.2-3. Note that the four differential energy flux maximum channel identifiers (0EM, 0PM, 3EM and 3PM) are each four bits long (each identifies 1 of 16 channels) and are combined into two 8 bit words (0EM/0PM and 3EM/3PM). Note also that two (0 and 30 degrees) proton four-point differential energy spectra are read out only three times every 32 seconds, while the two (0 and 30 degrees) electron four-point differential energy spectra are read out four times every 32 seconds (every 8 seconds). Sensor background data and synchronization words are read out in place of the fourth proton four-point differential energy spectral data.

Table 4.3.4.2-1. SEM Digital "A" Telemetry Data Assignments.

Minor Frame #	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	Housekeeping
Data in Word 20	CKSM	TED SWP VAN	TED E CEM HV	TED P CEM HV	MEP OMNI BV	AN SUB 1	AN SUB 2	AN SUB 3	AN SUB 4	TED IFC V	MEP IFC V	BL 1	BL 2	BL SUB	0E BK H	3EB KH	
Data in Word 21	0P1	SUB5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
.1 sec	1 0P2 0P3	21 - -	41 - -	61 - -	81 - -	101 - -	121 - -	141 - -	161 - -	181 - -	201 - -	221 - -	241 - -	261 - -	281 - -	301 - -	MEPED 0 degree Telescope
	2 0P4 0P5	22 - -	42 - -	62 - -	82 - -	102 - -	122 - -	142 - -	162 - -	182 - -	202 - -	222 - -	242 - -	262 - -	282 - -	302 - -	
	3 0P6 0E1	23 - -	43 - -	63 - -	83 - -	103 - -	123 - -	143 - -	163 - -	183 - -	203 - -	223 - -	243 - -	263 - -	283 - -	303 - -	
	4 0E2 0E3	24 - -	44 - -	64 - -	84 - -	104 - -	124 - -	144 - -	164 - -	184 - -	204 - -	224 - -	244 - -	264 - -	284 - -	304 - -	
	5 9P1 9P2	25 - -	45 - -	65 - -	85 - -	105 - -	125 - -	145 - -	165 - -	185 - -	205 - -	225 - -	245 - -	265 - -	285 - -	305 - -	MEPED 90 degree Telescope
	6 9P3 9P4	26 - -	46 - -	66 - -	86 - -	106 - -	126 - -	146 - -	166 - -	186 - -	206 - -	226 - -	246 - -	266 - -	286 - -	306 - -	
	7 9P5 9P6	27 - -	47 - -	67 - -	87 - -	107 - -	127 - -	147 - -	167 - -	187 - -	207 - -	227 - -	247 - -	267 - -	287 - -	307 - -	
	8 9E1 9E2	28 - -	48 - -	68 - -	88 - -	108 - -	128 - -	148 - -	168 - -	188 - -	208 - -	228 - -	248 - -	268 - -	288 - -	308 - -	

	9 9E3 P6	29 - -	49 - -	69 - -	89 - -	109 - -	129 - -	149 - -	169 - -	189 - -	209 - -	229 - -	249 - -	269 - -	289 - -	309 - -	MEPEDOMNI
.1 sec	10 P7 P8	30 - -	50 - -	70 - -	90 - -	110 - -	130 - -	150 - -	170 - -	190 - -	210 - -	230 - -	250 - -	270 - -	290 - -	310 - -	
	11 0DE1 0DE2	31 3DE1 3DE2	51 0DP1 0DP2	71 3DP1 3DP2	91 0DE1 0DE2	111 3DE1 3DE2	131 0DP1 0DP2	151 3DP1 3DP2	171 0DE1 0DE2	191 3DE1 3DE2	211 0DP1 0DP2	231 3DP1 3DP2	251 0DE1 0DE2	271 3DE1 3DE2	291 0EBKL 3EBKL	311 SyncF3 3PBKL	TEDDiffEnergy
	12 0DE3 0DE4	32 3DE3 3DE4	52 0DP3 0DP4	72 3DP3 3DP4	92 0DE3 0DE4	112 3ED3 3DE4	132 0DP3 0DP4	152 3DP3 3DP4	172 0DE3 0DE4	192 3DE3 3DE4	212 0DP3 0DP4	232 3DP3 3DP4	252 0DE3 0DE4	272 3DE3 3DE4	292 0PBKL 0PBKH	312 Sync 50 3PBKH	
	13 0EFL 3EFL	33 - -	53 - -	73 - -	93 - -	113 - -	133 - -	153 - -	173 - -	193 - -	213 - -	233 - -	253 - -	273 - -	293 - -	313 - -	TEDLowEnergyFlux
	14 0PFL 3PFL	34 - -	54 - -	74 - -	94 - -	114 - -	134 - -	154 - -	174 - -	194 - -	214 - -	234 - -	254 - -	274 - -	294 - -	314 - -	
	15 0EFH 3EFH	35 - -	55 - -	75 - -	95 - -	115 - -	135 - -	155 - -	175 - -	195 - -	215 - -	235 - -	255 - -	275 - -	295 - -	315 - -	TEDHighEnergyFlux
	16 0EFH 3PFH	36 - -	56 - -	76 - -	96 - -	116 - -	136 - -	156 - -	176 - -	196 - -	216 - -	236 - -	256 - -	276 - -	296 - -	316 - -	

	17 0EM/0 PM/ 0DEM	37 - - -	57 - - -	77 - - -	97 - - -	117 - - -	137 - - -	157 - - -	177 - - -	197 - - -	217 - - -	237 - - -	257 - - -	277 - - -	297 - - -	317 - - -	TEDPERKFLUX
	18 0DPM 3EM/ 3PM	38 - - -	58 - - -	78 - - -	98 - - -	118 - - -	138 - - -	158 - - -	178 - - -	198 - - -	218 - - -	238 - - -	258 - - -	278 - - -	298 - - -	318 - - -	
	19 3DEM 3DPM	39 - - -	59 - - -	79 - - -	99 - - -	119 - - -	139 - - -	159 - - -	179 - - -	199 - - -	219 - - -	239 - - -	259 - - -	279 - - -	299 - - -	319 - - -	
		2 sec	4 sec		8 sec				16 sec				24 sec				32 sec
Note: Dash indicates data is the same as in previous column.																	

Table 4.3.4.2-2. MEPED Digital "A" Data.				
Particle Type	**Sensor**	**Detected Energy Range**	**Readout Time(s)**	**Mnemonics**
Proton	Telescope 0/90 Degrees	30-80 keV	2	0P1, 9P1
		80-250 keV	2	0P2, 9P2
		250-800 keV	2	0P3, 9P3
		800-2500 keV	2	0P4, 9P4
		2500-7000 keV	2	0P5, 9P5
		>7000 keV	2	0P6, 9P6
Electron	Telescope 0/90 Degrees	≥30 keV	2	0E1, 9E1
		≥100 keV	2	0E2, 9E2
		≥300 keV	2	0E3, 9E3
Proton	Omni-directional	≥16 MeV	2	P6
		≥35 MeV	2	P7
		≥70 MeV	4	P8
		≥140 MeV	4	P9

Table 4.3.4.2-3. TED Digital "A" Data.			
Definition (Note 1)	**Readout Time(s)**	**Mnemonics**	**Notes**
0.05-1 keV Partial Energy Flux	2	0EFL, 0PFL, 3EFL, 3PFL	
2-10 keV Partial Energy Flux	2	0EFH, 0PFH, 3EFH, 3PFH	
Maximum Differential Energy Flux	2	0DEM, 0EPM, 3DEM, 3DPM	
Energy of Maximum Differential Energy Flux	2	0EM, 0PM, 3EM, 3PM	2
Four Point Energy/Flux Spectrum	8	0DE1, 0DE2, 0DE3, 0DE4 3DE1, 3DE2, 3DE3, 3DE4 0DP1, 0DP2, 0DP3, 0DP4 3DP1, 3DP2, 3DP3, 3DP4	3,4

Background	32	03BKH, 0EBKL, 0PBKH, 0PBKL	

Notes:
1) Four sets of measurements are made: electrons at 0 degrees, protons at 0 degrees, electrons at 30 degrees and protons at 30 degrees.
2) Four bits each, combined into two data words (0EM/0PM and 3EM/3PM).
3) Differential energy channels 4, 8, 11 and 14 (based on 1-16).
4) The four-point proton spectra are read three times every 32 seconds.

4.3.4.3 SBUV/2

Digital "A" data is clocked into the spacecraft TIP whenever the "A_1" Data Enable Pulse is presented to the instrument. Digital "A" data include both instrument data and any housekeeping telemetry required for reduction of observation data. The data format differs with the various SBUV/2 operating modes as described below.

4.3.4.3.1 Discrete Mode - The instrument views the earth's atmosphere, or the sun if the diffuser is so deployed. In this mode, radiometric data is taken at twelve discrete wavelengths. The data format for this mode is shown in Table 4.3.4.3.1-1. Further details of the data format are provided in Tables 4.3.4.3.1-2, 4.3.4.3.1-3, 4.3.4.3.1-4, 4.3.4.3.1-5 and 4.3.4.3.1-6, while Table 4.3.4.3.1-7 contains the TIP minor frame format.

4.3.4.3.2 Sweep Mode - The instrument grating sweeps from approximately 400 nm to 160 nm, and data is taken in 0.15 nm increments. If SBUV/2 is viewing the earth, the scene spectral radiance is being measured. If the diffuser is deployed, the instrument is measuring the solar irradiance.

4.3.4.3.3 Wavelength Calibration Mode - The instrument views an on-board Hg lamp source at 12 discrete grating positions bracketing a particular source line. The data format for this mode is the same as that for the Discrete Mode, as shown in Table 4.3.4.3.1-1.

Table 4.3.4.3.1-1. SBUV/2 Data Format Discrete Modes (1).

Line (3)	TIP Minor Frames (2)	Function		Sample Time		Integration Interval	
		Word 1 (4)	Word 2 (4)	Word 1 (7)	Word 2	Word 1	Word 2
L0	0, 10,20,..., 310	Status Word 1	Range 1 Data	End of L0, Channel N-1	End of L9, Channel N-1	n/a	1 1/4 sec and 1/4 sec (8)
L1	1, 11,21,..., 311	Status Word 2	Range 2 Data	Channel N-1	End of L9, Channel N-1	n/a	1 1/4 sec and 1/4 sec (8)
L2	2, 12,22,..., 312	Analog Sub Mux	Range 3 Data	End of L0/L1, Channel N	End of L9, Channel N-1	0.1	1 1/4 sec and 1/4 sec (8)
L3	3, 13,23,..., 313	Memory Verify	0000	End of L1, Channel N	n/a	n/a	n/a
L4	4, 14,24,..., 314	Status Word 3	0000	Start of L0, Channel N	n/a	n/a	n/a

L5	5, 15,25,..., 315	Status Word 4	0000	Start of L0, Channel N	n/a	n/a	n/a
L6	6, 16, 26,...,316	Grating Position	0000	½ into L7 Alternates End of L9, Chan N-1	n/a	n/a	n/a
L7	7, 17,27,..., 317	CCR Data	0000	End of L9, Channel N-1	n/a	1 1/4 sec (8) and 1/4 sec	n/a
L8	8, 18,28,...,318	RDCL/ GPE(6)	0000	End of L6/L7, Channel N	n/a	0.1 sec	n/a
L9	9, 19, 29,...,319	Frame Sync Code	0000	Start of L0, Channel N	n/a	n/a	n/a

Notes:
1) Includes discrete, calibration and position modes.
2) Format is the same for all major frames.
3) The basic SBUV/2 data frame is a 20-word block repeating at one second intervals.
4) Word 1 corresponds to the 16 bits in TIP words 36 and 37, MSB sent first. Word 2 corresponds to the 16 bits in TIP words 80 and 81, MSB sent first.
5) Analog sub-mux is 16 channels deep.
6) Radiometric DC level/grating position error.
7) Channel N is the present 1 second time interval. Channel N-1 is the previous 1 second time interval.
8) In every two second interval, signal integration occurs between 3/4 and 2 secs; signal is sampled and readout at the end of 1 sec and 2 secs.

Table 4.3.4.3.1-2. SBUV/2 Data Format Discrete Mode Detailed Description.

Name of Function	Format Location		Bit Numbers MSB LSB															
	Word	Line	1 16	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Frame Sync Code and Sub-multiplexer Channel Number	1	9	2^3	2^2	2^1	2^0	1	1	0	1	0	1	1	0	0	0	0	0
Frame Sync Sub-multiplexer Channel Numbers (Full Scale Counts 255=5.1 V, all analog channels)																		
Analog Sub-Mux (see Table 4.3.4.3.1-8 for commutation scheme)	1	2	Channel A								Channel B							
			2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Radiometric DC Level/Grating Position Error (3)	1	8	Full Scale Counts 255=5.1 Volts, Note: RDCL F.S. Current 91.5 pa															
Monochromator Range Data	2		2^{15} ----------2^0															
			Maximum Count = 65,535 (1), Full Scale Counts = 65,536															
							Full Scale Current											
							Disc						Sweep					
		0	Range 1(2)				100 pa						1.25 na					
		1	Range 2(2)				10 na						125 na					
		2	Range 3(2)				1 μa						12.5 μa					
Cloud Cover Radiometer Data	1	7	CCR				2.4 na						30 na					

<table>
<tr><td rowspan="6">Memory Verification
● Repeats every 128 secs
● Reads memory as indicated by memory bits shown to right
● Memory location readout in order starting with Word 0 segment 0 of fixed memory at TIP major frame pulse.</td><td>1</td><td>3</td><td colspan="3">2^{12} position data in Memory</td><td colspan="2">2^0 S^1 S^0 F</td></tr>
<tr><td>Segment</td><td>S^1</td><td>S^0</td><td>Program</td><td>F</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Fixed</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Flex</td><td>0</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td></td><td></td></tr>
<tr><td>3</td><td>1</td><td>1</td><td></td><td></td></tr>
<tr><td rowspan="7">Grating Position
Number greater than 0 = CW of Index,
Number less than 0 = CCW of Index

Index = all zeroes

1 bit CW = 0

1 bit CCW = all ones</td><td rowspan="7">1</td><td rowspan="7">6</td><td colspan="3">2^{12}</td><td>2^0 S_1 S_0 L</td></tr>
<tr><td>Segment Being Read</td><td>S_1</td><td>S_0</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>1</td><td>0</td></tr>
<tr><td>3</td><td>1</td><td>1</td></tr>
<tr><td colspan="4">This is the actual position number. Code is in 2's complement. Digital Lock L=1 (locked).</td></tr>
<tr><td>Range Identi-fication</td><td colspan="2">Status Words 1 and 2</td><td>Range Selected</td><td>Bit A</td><td colspan="2">Bit B</td></tr>
<tr><td></td><td></td><td></td><td>R_1</td><td>0</td><td colspan="2">1</td></tr>
</table>

		R_2	1	0		
		R_3	1	1		
Sweep Mode Major Frame Counter	Status Word 1 Bits 3,4 & 5	Frame	Count	Bit No.		
				3	4	5
		None	0	0	0	0
		(First)	1	0	0	1
		2	2	0	1	0
		3	3	0	1	1
		4	4	1	0	0
		5	5	1	0	1
		6 (Last)	6	1	1	0

Notes:
1) Overflow flags (status 3 bits 1, 2, 3, 4).
2) Current referred to the PMT anode.
3) Grating Motor Current, Grating Position Error, and Grating Coarse Error are expected to always read 0 to 10 counts (telemetry points are grounded) and data should be disregarded.

Table 4.3.4.3.1-3. SBUV/2 Data Format Discrete Mode Temperature Monitor Description.

Temperature Monitors:

1. Differential Monitors $T_D=T_A-T_R$; $N_A=N_R+0.1075\ N_D-13.7$ (1)
2. Single Pt Monitors:

Temp (Degrees C)	Thermistor (Ohms)	Output Volts/Counts (N)				
		Shroud -30 to 80	Differential A to B Reference	0 to 80 degrees	-15 to 45 degrees	-5 to 35 degrees
-30	135.2 K	4.74/237				
-20	78.91 K	4.57/228			5.15	
-15	61.02 K	4.45/222	3.58/179		5.01/250	
-10	47.54 K	4.32/216	3.41/170	5.513	4.84/242	5.17
-5	37.31 K	4.16/208	3.22/161			4.95/247
0	29.49 K	3.99/199	3.01/150	4.98/249	4.42/221	4.70/235
5	23.46 K	3.79/189	2.79/140			
10	18.79 K	3.57/178	2.57/128	4.35/217	3.92/196	4.13/206
15	15.13 K	3.34/167	2.33/117			
20	12.26 K	3.10/155	2.11/105	3.67/183	3.36/166	3.52/176
25	10.00 K	2.86/143	1.89/94	3.33/167	3.08/154	
30	8.194 K	2.61/130	1.68/84	3.00/150	2.79/139	2.90/145
35	6.752 K	2.37/118	1.48/74			2.60/130
40	5.592 K	2.14/107	1.30/65	2.39/119	2.25/112	2.32/116
45	4.655 K	1.91/95	1.14/57		2.01/100	
50	3.893 K	1.71/85		1.86/93	1.78/89	1.82/91
60	2.76 K	1.35/67		1.44/72	1.39/69	1.41/70
70	1.99 K	1.05/52		1.1/55	1.08/54	1.09/54
80	1.458 K	0.81/41		0.85/42	0.831/41	

Note:
(1) N_A = Thermistor "A" Temperature in counts, N_D = Differential Temperature in counts and N_R = Reference Temperature in counts.

Table 4.3.4.3.1-4. SBUV/2 Data Format Discrete Mode Voltage and Current Monitors Description.

Voltage Monitors	
Function	**Conversion Factor**
HVPS Volts	6 V/N (1)
E Cal Ref	0.04 V/N, 6.4 V/160 Counts Nominal, ± 0.6 V limits
15 V Sensors	0.1 V/N, 15 V/150 Counts Nominal, ± 3.0 V limits
-15 V Sensors	$V=0.6083_{N5} - 0.5059_{N15}$ (2)
24 V Motor	0.198 V/N, 24 V/121 Counts Nominal, ± 5 V limits
5 V LED	0.0333 V/N, 5V/150 Counts Nominal, ± 1 V limits
10 V Logic	0.0667 V/N, 10 V/150 Counts Nominal, ± 1 V limits
28 V*	9.912 V/N, 28V/2.82 V Nominal ±4 V limits
25 V	0.198 V/N, 25 V/126 Counts Nominal, ± 2.5 V limits
15 V Servo	0.1 V/N, 15 V/150 Counts Nominal, ±1.5 V limits
-15 V Servo	$V=0.6083_{N5} - 0.5059_{N15}$ (2)
Thermistor Bias (10 V)	0.0667 V/N, 10 V/150 Counts Nominal, ±1 V limits
Current Monitors	
Chop Motor	0.002 A/N
Diffuser Motor	0.004 A/N
Cal Lamp Current	5.22 μA/N
Lamp Motor	0.004 A/N
Cal Lamp Heater*	0.1 A/volt 0.17 A nominal
Miscellaneous	

Chopper Phase Error 1) N=counts 2) N_5 counts from 5V LED	0.0985 V/N
Note: * Analog Telemetry	

Table 4.3.4.3.1-5. SBUV/2 Description of Command Sequence State Monitors.

Command (CMD) Sequence State					
		2^2	2^1	2^0	
Discrete Sun Command Sequence	1-0	0	0	0	Discrete Sun Enable ON
	1-1	0	0	1	
	1-2	0	1	0	
		All other states not valid			
Sweep Sun Command Sequence Step No.	2-0	0	0	0	Sweep Sun Enable ON
	2-1	0	0	1	
	2-2	0	1	0	
	2-3	0	1	1	
		All other states not valid			
W/L*Calibration Command Sequence Step No.	3-0	0	0	0	W/L Calibration Enable ON
	3-1	0	0	1	
	3-2	0	1	0	
	3-3	0	1	1	
	3-4	1	0	0	
	3-5	1	0	1	
	3-6	1	1	0	
	3-7	1	1	1	
		All other states not valid			
Note: *W/L= wavelength					

Table 4.3.4.3.1-6. SBUV/2 Data Description of the Electronic Calibration Step Decoding using Timing Monitors and the Retrace Monitor.				
	Timing Monitors			
E Cal Step No.	**16 sec**	**8 sec**	**4 sec**	**Retrace**
A	1	0	0	ON
B	1	0	1	
C	1	1	0	
D	1	1	1	
E	0	0	0	
A	0	0	1	
A	0	1	0	
A	0	1	1	
E Cal OFF				OFF
Note: Timing monitors are sampled at Channel N-1 (1 sec prior to readout).				

Table 4.3.4.3.1-7. TIP Minor Frame Format.			
Function	No. of words	Word position	Bit No. 1 2 3 4 5 6 7 8 Plus Word Code & Meaning
Frame Sync & S/C ID	3	0 1 2	1 1 1 0 1 1 0 1 (MSB is first) 1 1 1 0 0 0 1 0 0 0 0 0 A A A A (Last 4 bits are spacecraft ID)
Status	1-	3	Bit 1: Cmd verification (cv) status; 1=cv update word present in frame; 0=no cv update in frame Bits 2&3: TIP status; 00=orbital mode; 10=CPU Memory Dump Mode; 01=Dwell Mode; 11=Boost Mode Bits 4-6: Major Frame Count; 000=Major Frame 0; 111=Major Frame 7; MSB first; Counter incremented every 320 minor frames
Dwell Mode Address	1+	3 4	Bits 7&8, Bits 1-7: 9 bit dwell mode address of analog channel that is being monitored continuously 000000000= Analog channel 0 111111111= Analog channel 511

Minor Frame Counter	1+	4 5	Bit 8, Bits 1-8: 000000000= Minor Frame 0 100111111= Minor Frame 319
Command Verifi-cation	2	6 7	Bits 9 thru 24 of each valid received or stored command word are placed in the 16 bit slots of telemetry words 6 and 7 on a one-for-one basis.
Time Code	5	8,9 9 9,10, 11 12	9 bits of Binary Day Count, MSB first Bits 2-5: 0 1 0 1, Spare bits 27 bits of Binary millisec of Day Count, MSB first Time code is inserted in word location 8-12 only in minor frame 0 of every major frame. The data inserted is referenced to the beginning of the first bit of the minor frame sync word of minor frame 0 within ±1 millisecond.
Digital "B" Subcom-1	1	8	A subcommutation of Discrete Inputs collected to form 8 bit words. 256 Discrete Inputs (32 words) can be accommodated. It takes 32 frames to sample all inputs once (sampling rate=once/3.2 sec). A Major Frame contains 10 complete Digital "B" subcommutated frames.
Analog Subcom (32 sec)	1	9	A subcommutation of up to 191 analog points sampled once every 32 seconds plus 64 analog points sampled twice every 32 seconds (once every 16 seconds). Bit 1 of each word represents 2560 mV, while Bit 8 represents 20 mV.
Analog Subcom (16 sec)	1	10	This subcommutation is controlled by a PROM located in the TIP and contains 160 word locations with 128 analog channels sampled once every 16 seconds.
Analog Subcom (1 sec)	1	11	This subcommutation is controlled by a PROM in the TIP and contains 10 analog channels sampled once every 1 second. Word 0 of this subcom is filled with data from an analog point selected by command. The selected analog point may be any of the 512 analog points available to the TIP. Bit 1 of each word represents 2560 mV while Bit 8 represents 20 mV.
Digital "B" Subcom-2	1	12	The subcommutation of discrete inputs collected to form 8 Bit words. 256 discrete inputs (32 words) can be accommodated. It takes 32 minor frames to sample all inputs once (sampling rate=once/3.2 sec). A Major Frame contains 10 complete Digital "B" subcommutated frames. 64 of these Bit locations corresponding to TIP minor frames 24-31 form the XSU Digital "A" data. The XSU generates an 8 word subcom which is read out at the rate of one word per minor frame. The XSU subcom is synchronized with its word 1 in minor frame 24.
Analog Subcom-2 (16 sec)	1	13	This subcommutation is controlled by a PROM located in the TIP and contains 160 word locations with 128 analog channels sampled once every 16 seconds. The remaining 32 word locations contain data from the Solar Array Telemetry Commutator Unit (SATCU). The SATCU receives inputs from 16 sources on the solar array, commutates them and presents this output to the TIP on channel 282. The TIP formats this stream and presents it in the last 32 word locations. The 32 words represent two successive passes through the SATCU subcom.

DAU-1	1	14	8 Bit Housekeeping Telemetry words are formed by the DAU-1 and read out by the telemetry system an average rate of 10 words per second.
DAU-2	1	15	8 Bit Housekeeping Telemetry words are formed by the DAU-2 and read out by the telemetry system at an average rate of 10 words per second.
HIRS/3	36	16,17, 22,23, 26,27, 30,31, 34,35, 38,39, 42,43, 54,55, 58,59, 62,63, 66,67, 70,71, 74,75, 78,79, 82,83, 84,85, 88,89, 92,93	8 Bit words are formed by the HIRS/3 experiment and are read out by the telemetry system at an average rate of 360 words per second.
SEM	2	20,21	8 Bit words are formed by the SEM sensor and read out by the telemetry system at an average rate of 20 words per second.
DCS-2	32	18,19, 24,25, 28,29, 32,33, 40,41, 44,45, 52,53, 56,57, 60,61, 64,65, 68,69, 72,73, 76,77, 86,87, 90,91, 94,95	8 Bit words are formed by the DCS experiment and are read out by the telemetry system at an average rate of 320 words per second.
SBUV/2	4	36,37, 80,81	8 Bit words are formed by the SBUV/2 experiment and read out by the telemetry system at an average rate of 40 words per second.
CPU A Telemetry	6	46,47, 48,49, 50,51	A block of three 16 Bit CPU words is read out by the telemetry system every minor frame.

CPU B Telemetry	6	96,97, 98,99, 100,10 1	A second block of three 16 Bit CPU words is read out by the telemetry system every minor frame.
CPU Data Status	1-	103	Bits 1 and 2: 00= All CPU data received 01= All CPU A data received; CPU B data incomplete 10= All CPU B data received; CPU A data incomplete 11= CPU A and CPU B data incomplete
Parity	1-	103	Bit 3: Even parity check in words 2 thru 18 Bit 4: Even parity check in words 19 thru 35 Bit 5: Even parity check in words 36 thru 52 Bit 6: Even parity check in words 53 thru 69 Bit 7: Even parity check in words 70 thru 86 Bit 8: Even parity check in words 87 thru bit 7 of word 103

Table 4.3.4.3.1-8. SBUV/2 Data Format Discrete Mode Analog Sub-Multiplexer Data Assignment.

Bits 1 through 8 Channel A		Bits 9 through 16 Channel B	
Channel #	**Function**	**Channel #**	**Function**
1A	Chop Motor Current	1B	Spare
2A	Differential Motor Current	2B	Diffuser Plate Temperature (1)
3A	HVPS Volts	3B	SM Baseplate Temperature (2)
4A	Thermistor Bias (10 V Reference)	4B	25 V Power Volts
5A	Calibration Lamp Temperature (1)	5B	15 V Servo Volts
6A	Electronic Calibration Reference Volts	6B	-15 V Servo Volts
7A	15 V Sensors Volts	7B	CCR Diode Temperature (3)
8A	-15 V Sensors Volts	8B	SM Differential Temperature Y Axis (4)
9A	24 V Motor Volts	9B	SM Differential Temperature Z Axis (4)
10A	5 V LED Volts	10B	Differential Reference Temperature Z Axis

11A	10 V Logic Volts	11B	Differential Reference Temperature Y Axis
12A	Calibration Lamp Current	12B	PMT Cathode Temperature (3)
13A	Spare	13B	Spare
14A	Signal Return	14B	Chopper Phase Error
15A	Signal Return	15B	Spare
16A	Lamp Motor Current	16B	Spare

Notes:
(1) 0 to 80 degrees C
(2) -15 to 45 degrees C
(3) -5 to 35 degrees C
(4) ± 5 degrees C

4.4 DATA COLLECTION AND LOCATION SYSTEM

4.4.1 GENERAL

The Data Collection System (DCS) on the NOAA KLM spacecraft is provided by CNES of France. This system provides a means to collect data and/or locate fixed and mobile buoy and balloon platforms. A complete description of the system is contained in Section 3.6.

If the data platforms and receive site are simultaneously in the view of the satellite, the Data Collection System provides the immediate rebroadcast of data from the platform, received by the satellite via an UHF uplink. These data are included as 32 8-bit words in the TIP minor frame. As such, it is available in both the low data rate DSB and high data rate HRPT services. Since the data rate on the new DCS/2 instrument has been increased from 1200 to 2560 bps, the number of TIP words allocated to DCS has been increased to 32 from the previous spacecraft series. However, interpretation of the telemetry remains unchanged. The DCS data in the direct broadcast services will only permit platform location computations with the proper computer software. More details can be obtained from Service ARGOS, as noted in Appendix E.